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THE SYMBIOSIS OF STOCK AND GRAFT.

BY ERWIN F. SMITH.

Under the title, Ueber Transplantation am Pflanzenkörper, (pp. VI, 162, Pl. XI, figs. 14), Dr. Hermann Vöchting, Prof. of botany in the University of Tübingen, has contributed a study on the relations of graft and stock which is of unusual interest. After some consideration of the literature of the subject he discusses (1) Methods of grafting, (a) Grafting of like parts in normal and abnormal positions; (b) Grafting of unlike parts; (2) The symbiosis of scion and stock; (3) Histological investigations. The author's conclusions relative to the mutual relations of stock and graft rest upon careful experiments covering a period of some years. His first experiments consisted in the union of parts of the same and related varieties of the red beet. The top of a plant recently grown from the seed but sufficiently large was cut away and young shoots from two-year old blossoming plants were grafted on. These cions were taken from the base of recently developed shoots and bore from two to three vegetative buds. These buds grew into short, fleshy sprouts plentifully provided with leaves which resembled those of the *first year*, i. e. were not like those on the blossom shoot from which they were taken. Subsequently the axis also became thickened but to a less degree. The shoots did not produce blossoms but elaborated food for

their own use and that of the root. The roots also increased in circumference in proportion to the amount of their nourishment. This growth was excentric and preponderatingly under the cion. The following year blossoms were produced in the ordinary manner and death followed. *Conclusion:* If these shoots had remained on the parent plant, they would have blossomed the same season and died in the fall. Inserting them on the young root changed them into a vegetative state and prolonged their life for a whole year. In this case the young root exerted the controlling influence. In another experiment plants at the commencement of the second year were divided into two lots. The plants of one set were forced into a rapid development of blossoms; the others were restrained from blossoming by being kept in a cool place. The tops of the retarded plants were cut away and cions from the forced plants were inserted. The result of this experiment was quite different. These cions developed blossoms in the normal way. None of them remained short or formed the tufts of broad leaves which were peculiar to the sprouts in the previous experiment. In this case the leaves had long petioles and rather narrow blades as in ordinary blossom shoots. Here likewise the roots increased in size near the inserts, i. e. around them and below. *Conclusion:* Grafting on young and old roots leads to very different results.

Knight's law, expressed still more clearly by van Mons, that only its own nature controls the development of the cion, is not universally true. Cion and stock mutually influence each other always. Sometimes one preponderates in influence, sometimes the other. The control exercised by the stock in these experiments with the beets is ascribed to movement of assimilative matters (stoffwechsel). The young root grows and stores up reserve materials, chiefly sugar. The old root does not grow, gives up its reserve materials, and dies after it is emptied. "It is plain," says the author, "that the manner of growth of the bud, i. e. its development into a vegetative or floral shoot, depends less upon itself than upon the parts bearing reserve substances, especially the roots."

In the middle of June, segments were removed from old roots, then producing blossoms, and were inserted into young, actively-growing roots, only recently developed from the seed. There was union of tissues but no increase in circumference, no radial growth. When these inserted pieces were examined the following winter they were, unexpectedly, found full of sugar. The cells bore abundant plasma, fine nuclei, and seemed to be in good condition, although at the time of their insertion they had given up the greater part of their reserve materials. The only possible conclusion is that the root inserts had formed new cane sugar out of the materials brought to them by the young roots. Old beets were set into young roots and in this way also their life was prolonged, the old parts dying only a little earlier than the young roots. In this case they showed no such quantity of sugar. Inasmuch as these old roots did not increase in thickness in spite of their good nourishment by the young roots it might be inferred that they are not capable of it, but such an inference would be wrong. Segments of old roots taken in the middle of March and inserted into the basal parts of panicles in rapid development showed a marked growth, what the author calls,—"ein sehr auffallendes Verhalten." They began a new process of development, grew up above the surface of the stem on a level with which they were originally inserted, and ended by forming swellings of various sizes and shapes. When the piece of root was inserted upside down it was swollen at the upper end, when it was inserted right end up the swelling was at the lower end. The stem around the insert also finally enlarged, sometimes only above the insert, sometimes also at both sides. The growth of these root-inserts was very remarkable. Under normal conditions the same pieces would have made no growth whatever. Planted in the blossoming stem they began to grow, and this growth was so energetic in some cases that the pieces increased to several times their original volume. Dr. Vöchting is in doubt as to the cause of this behavior, but concludes from it that there is no necessary relation between growth and the storing of sugar since he found these growths very poor in sugar although the cells appeared to be active.

Some attempts were made to unite annuals and perennials. The tomato was used for a stock, the author not being aware, apparently, that the tomato is not strictly annual but frequently lives far into the second year and even longer in green houses and in warm climates. In the first series of experiments cions of *Solanum dulcamara* were grafted on. They made a good union and more growth than any shoots on the parent stem. In the fall the plants were removed to a house. Gradually the leaves fell off, but the sprouts remained fresh for a time. They died, however, in December or January, the disturbance beginning below with the stock. It was thought that owing possibly to the fall of the leaves and the cessation of the activity of the graft, it had not sufficiently stimulated the stock, so another experiment was made using as cions Solanum capsicum and S. *pseudocapsicum*, which hold their leaves over winter. A good union was secured and the plants developed fine tops and prospered until winter. In early winter the stocks became diseased at the root and the tops died quickly. One plant, however, held on longer and toward the end of December the part of the stock above ground formed adventive roots. In January the graft turned yellow and died. *Conclusion:* These experiments do not show that the life of annuals can be prolonged by grafting perennials upon them but it is not certain that such an end might not be reached by the use of other plants. An experiment was also made on *Mercurialis annua* which bears staminate and pistillate flowers on different plants. Portions of male and female plants were united by grafting but the result was negative, the sex remaining distinct. Mention is also made of a staminate Ginkgo tree in the Botanical Garden at Basle into which a pistillate branch was grafted many years ago. This has grown into a stately system of branches but the sexual parts are just as distinct as on separate trees. The same result has been reached in the same garden with *Acuba japonica.*

Plants of varied color and form were also grafted together. The more recent discussion of the symbiosis of cion and stock turns chiefly on the subject of the transmissibility of panachure and on the possibility of graft hybrids. A portion of the

white and yellow spotting of variegated leaves is unquestionably pathological and is readily transmitted by grafting. Since we do not know the cause of this disease, we can form no definite idea as to its method of transmission, yet the whole process of transmission gives the impression of an infection. How this takes place we do not know, but it seems as if it must be through the wandering of specific material particles out of the variegated cion into the stock. Concerning the transmission of non-pathological peculiarities such as colors, especially those held in the cell sap, the author thinks that they cannot pass directly into the stock, but that something must pass that is able to produce them. He saw in Bonn, Lindemuth's experiment in which violet color was transmitted from a potato cion to the green stock, and says it was so. His own experiments are as follows: *Coleus.* Many experiments with characteristic forms. The unions were easily affected and the plants were kept into the second year and some into the third year. *Conclusion:* In no case was there any transmission of color from the graft to the stock, or from the stock to the graft. Neither was there any influence on the form or nervation of the leaves. Cion and stock retained their original peculiarities unchanged. *Tradescantia:* The shoots of *T. zebrina* and *T. quadricolor* were grafted on the green *T. Sellowi.* The cions reached a considerable length but in no case was there any transmission of color. *Beets* (salad, fodder, and sugar): (a) *Union of different colored beets.* Dr. A. Maclean of Colchester, England, was the first to try this in 1853. He joined the root of a red beet to that of a white Silesian beet. They united but the red part remained sharply delimited from the white. There was no transmission of color or of form. In the author's own experiments white and orange, white and red of various shades, and yellow and light and dark red beets were united. In part of the experiments roots were joined to roots; in others shoots, to roots. With one exception there was no transmission of color from cion to stock or vice versa. Each part retained its own color. The blending of colors did not occur even in the region of the union. Microscopic examinations were made and the place of union

could be seen very distinctly. The exception was as follows: The shoot of a red beet was worked on the root of a white mangel wurzel? (Futterrübe) and subsequently a red color appeared in the swelling around the inserted cion. No such color was visible on the rest of the root, nor could any such be found on other ungrafted roots of this variety. It would seem that the color in this root was due to the influence of the graft and that this experiment supports Lindemuth's observations. Nevertheless this case is not entirely beyond suspicion since colored beets are apt to develop most color in the vicinity of wounds, and because all varieties of beets are nearly related and though apparently constant may possess latent peculiarities. (b) *Union of bodies of different sizes.* Very large white beets were grafted on small dark red ones and vice versa, the parts being about the same size when united. In the first case the plants grew more than in the second, i. e. because they had a larger leaf surface for assimilation. (c) *Union of varieties having unlike shapes.* Each grew after its own manner uninfluenced by the other. M. Gaillard tried grafting Cucurbitaceous plants and got the same result. White, green and yellow colocynths were united but there was no blending of colors.

Several attempts were made to procure graft-hybrids. The author wholly failed to get variegated hyacinth flowers by a union of different bulbs. Even when the union took place between blossom stalks there was no mixture. In experiments with potatoes his results confirm Lindemuth's. There was no mixture. Many experiments were tried using well marked and constant varieties very distinct in color and form. He discarded the tubers and worked with young, well-rooted shoots which were removed from the tubers, set out in the earth, and grafted as soon as they were a short distance above the ground. As soon as the cions were healed on, the plants were put into a hot bed. They remained here until the fall of the leaves in autumn, care being taken to remove all the green leaves which appeared from time to time on the stock so that it should be nourished only by the vegetation of the cion. At the close of the experiment the tubers were found to possess all of the peculiarities of the mother plant. The cions did not

produce any change either in color or form. In Strasburger's experiment of grafting Datura on potato and getting atropin in the tubers, if the malformation of part of these tubers was due to the presence of atropin then it is a case of poisoning and not of a change in the specific nature of the stock due to the cion, as Strasburger also admits. From the observations of Lindemuth there can be no doubt that many of the reports of graft hybrids rest on errors. Master's reported an experiment made by Maule of Bristol and exhibited a photograph showing *Helianthus tuberosus* grafted on *H. annuus* and the roots of the latter bearing tuberous growths. This experiment was repeated by M. Carriere, a very careful observer, and on the roots of his *Helianthus annuus* appeared two budless black swellings with a rifted surface, and in general resembling certain dahlia tubers. In the vicinity of these were other forms which more nearly resembled the artichoke. This experiment should be repeated. *Conclusion:* Either there are no such things as graft hybrids or else they are limited to a small number of plants.

ON A SUPPOSED CASE OF PARALLELISM IN THE GENUS PALAEOSYOPS.

By Charles Earle.[1]

The object of the present paper is to attempt to show that in the extinct perissodactyle Palaeosyops, the species developed at least two parallel series, both of which may have lead to some permanent result. In other words, from a very thorough study of the known species of this genus, I am lead to the conclusion that the genus Titanotherium may have had a polyphyletic origin. This will be impossible to prove until we know more of that intermediate form *Diplacodon.*

Little has been attempted in the construction of the phylogenies of species of fossil mammals, although a great deal has been done in this respect in regard to genera. I attempted it in my "Memoir on Palaeosyops," but the recent acquisition of new material proves that I made some mistakes in my phylogenetic scheme. As our knowledge of Palaeosyops now stands, we know considerable about the structure of the skeleton in a number of well defined species, and in some cases the complete osteology is known.

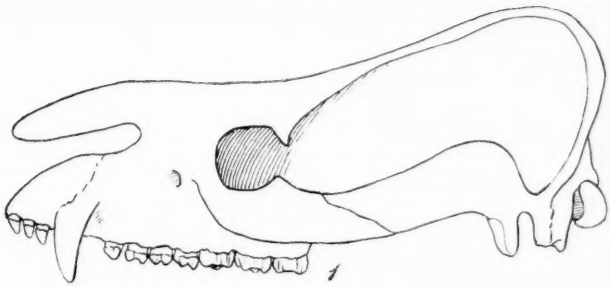
Professor Cope was one of the first to call attention to the phenomenon of the parallelism of genera. Professor Scott[2] in his series of valuable papers has placed before us a thorough exposition of what we have to attempt in paleontological investigation, and especially the relation of the latter to the facts of evolution. In the "Deep River Mammals" he remarks[3] "only very rarely can we construct a phylogeny of species as distinguished from that of genera, and the latter are too vague for the purpose."

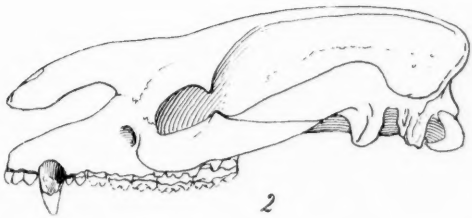
[1] American Museum of Natural History, New York.

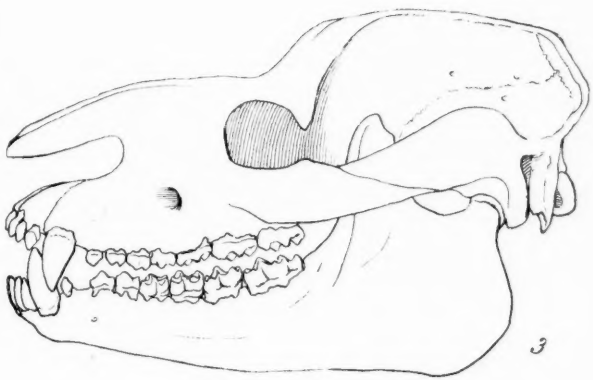
[2] Phylogeny of the Tylopoda. Journal of Morphology, Vol. p. .
Osteology of Mesohippus and Leptomeryx. Journal of Morphology. Vol. V, p. 301.
The Mammalia of the Deep River Beds. Proc. Am. Phil. Soc., 1894.

[3] Page 119.

PLATE XXVII.







Earle on Palaeosyops.

Quite a large number of species of Titanotherium have been already described, but as a whole this genus is remarkably homogeneous in the characters of the species, and it is very uncertain how many there really are. The deeply concave or saddle-shaped skull is typical, I believe, of all the known species. The case with Palaeosyops is quite different, as this genus exhibits a great variety in its specific forms, fully as great, if not greater than Palaeotherium of the Middle Eocene of Europe.

Within the past summer some exceedingly valuable material of Palaeosyops has been collected for the American Museum of Natural History by Mr. O. A. Peterson of the Museum; and this has just been described in bulletin form by Professor Osborn. We are greatly indebted to this bulletin for its important information in regard to the stratigraphical relations of the skulls of Palaeosyops. This material was collected in the country just south of the Uinta Mountains, and the deposit which occurs in this area was always supposed to pertain only to the Uinta or Upper Eocene. Mr. Peterson discovered skulls of a species of Palaeosyops in this region, namely, *P. megarhinus*, which is typical of the Bridger proper, and, in fact, he found one skull of this species or a variety of the same, which is the earliest one known of this form. This skull came from the base of the beds under the Uinta, which is considered to be the bottom of the Bridger. Mr. Peterson informs me that Palaeosyops occurs from this position in the beds as far up as just beneath the Uinta proper. Furthermore, in the uppermost of the transition beds, between the Bridger and Uinta proper, Mr. Peterson discovered a number of large skulls of a supposed new type of Palaeosyops, but I think I can quite safely say that this form really belongs to the genus *Telmatotherium* Marsh (*Leurocephalus* S. & O.). The characters of these skulls nearly demonstrate my views as to the phylogenetic relationship of Palaeosyops to Telmatotherium, and in my memoir on the former genus I remarked "I consider that Telmatotherium is the most highly specialized genus of the Palaeosyopinae approaching more closely in its dental characters (skull unknown at that time) to Diplacodon than any other genus of

the subfamily, Telmatotherium should, therefore, hold an intermediate position between Palaeosyops and Diplacodon."

It is interesting to note that these newly discovered skulls of Telmatotherium are merely greatly enlarged ones of the *P. megarhinus* type (see fig. 2), and that other skulls in the collection of the American Museum show the transition stages between the generalized form of *P. megarhinus* and that of the Telmatotherium type from the uppermost part of the transition beds already referred to.

In the Bridger proper or the area of southwestern Wyoming, just north of the Uinta Mountains, occur at least three well defined types of skulls of Palaeosyops, namely, that of *P. paludosus*, with frontal region strongly convex and occipital portion broad and heavy (see fig. 3). The character of the teeth in this species is very primitive, but it has a specialized form of skull.

2. The type which Marsh called Limnohyops. I recognized this as a good genus in my memoir, but I now believe that it should be included in Palaeosyops. In *P.* (*Limnohyops*) *laticeps* the skull is saddle-shaped like that of Titanotherium, and I called particular attention to this fact in the paper already quoted (see fig. 1).

3. The *P. megarhinus* type of skull is the most primitive of all, there is hardly any depression on the dorsal surface, and the sagittal crest is well defined. The teeth are tending towards those of Telmatotherium, as they have broad and angular crescents, with a reduction of the intermediate tubercles (see fig. 2). I wish to emphasize particularly that in the Bridger proper, the saddle-shaped type of skull was established, and contemporaneous with it was the much more primitive skull of *P. megarhinus*. I accordingly did not suspect that the latter was in the direct line leading to Diplacodon. However, the discovery of the skull of this species south of the Uinta Mountains and its relationship to Telmatotherium, has made necessary some changes in the phylogeny of the species of Palaeosyops, and I now find that there were two well defined lines of Palaeosyops tending in the characters of their skulls and dentition towards Titanotherium, and that these two

series were parallel in many of their characters, although the *P. megarhinus*-Telmatotherium division did not commence to differentiate those characters which are found in Titanotherium as early as the *P. laticeps*-*P. vallidens* series.

In the following table I have arranged some of the species of Palaeosyops phylogenetically and in three parallel columns, two of which are supposed to contain persistent types. The third column contains the more specialized species, which are are supposed to have died out.

In conclusion I wish to emphasize the following points:—

The first series exhibits transition in the structure of the the teeth and skull which is quite gradual, although in the most highly differentiated form of this line, namely, Telmatotherium sp. nov. (type specimen in American Museum collection), the dorsal contour of the skull is slightly convex and not saddle-shaped as in Titanotherium. This series began to differentiate later, as already shown, than the second series; this is proven by the presence in the Bridger proper of the supposed earliest members of the two lines, namely, *P. megarhinus*, which has a skull with a nearly straight dorsal contour, and the ancestor of the second line, namely, *P. laticeps*, with a skull which is deeply concave like that of the White River genus Titanotherium.

2. The changes from *P. laticeps* to *P. vallidens* parallels that of the first series in many ways, notably the increased height of the crowns of the molars, reduction of the intermediate tubercles, increase in size of the skull, and lastly some indications of the development of horns.

3. The great variety of species occurring in the genus Palaeosyops indicates progression and advancement towards a higher type, although we observe that a number of the species probably left no descendants. In the genus Titanotherium, which was approaching extinction, we see fewer well marked species and much closer similarity between them than between those of Palaeosyops.

TABLE.

Parallel Series I. Persistent Types.	Parallel Series II. Persistent Types.	Specialized Forms. Non-persistent.
1. *P. megarhinus* (variety) Earle. Skull small, sagittal crest long and high. Last superior molar with hypocone. From base of Bridger.	1. *Palaeosyops* (*Limnohyops*) *laticeps* Marsh. Skull saddle shaped as in *Titanotherium*. Zygomatic arch strong and robust. Nasals long and slender. Superior molars with short crowns and well developed intermediate tubercles. Last upper molar with hypocone. Bridger Proper.	*Palaeosyops paludosus* Leidy. Skull short and broad, with frontal region strongly convex. Teeth primitive, with low crowns and well developed intermediate tubercles. Bridger Proper.
2. *P. megarhinus* Earle. Skull larger, sagital crest not as prominent and long. No frontal depression. Molar insertion strongly depressed, zygomatic arch narrow and slender as in Diplacodon. Nasals elongated and broad distally. Molar crowns tending to become elongated and intermediate tubercles reduced. From the Bridger Proper.	2. *Palaeosyops vallidens* Cope. Skull saddle-shaped and much larger than the above species. Zygomatic arch not depressed at the molar insertion and rising gradually from the cheek. Molar crowns not as high and angular as in *Telmatotherium*, but show a reduction of intermediates. Last superior molar with hypocone rudimentary. Rugosities at junction of frontals and nasals, ? incipient horns. Washakie Eocene.	*Palaeosyops* (*Limnohyops*) *fontinalis* Cope. A small species with molars of the Telmatotherium type, namely, with rather high crowns, angular crescents, with hypocone on M 3 as large as protocone. Bridger Proper.
3. *Telmatotherium cornutum*, Osborn. Type in American Museum. Skull twice as large as former species. No sagittal crest, frontal region slightly convex and temporal ridges widely separated. Character of molar and zygoma, as well as nasals, the same as in *P. megarhinus*. Molars with crowns high and crescents more angular, no intermediate tubercles. Indications of incipient horns. Transition beds of Bridger, just below the Uinta proper.	*? Telmatotherium hyognathus S. & O.* This species is represented by a large jaw in the Princeton collection. Generic reference uncertain. Washakie.	

BIRDS OF NEW GUINEA (MISCELLANEOUS).

By G. S. Mead.

(*Continued from page 417*).

Considerable uncertainty exists in regard to the different species of *Rectes*. The lines of division between them have not been clearly drawn; accordingly, we are in possession of more names than birds, the difficulty arising from insufficient information as to the size, age, locality and even sex of the specimens described. Passing over two or three doubtful forms we meet with a species new to science when D'Albertis and Salvadori first saw it. It is *R. brunneiceps*. The back and scapulars are a bright cinnamon, the head and neck a clouded brown, the breast, abdomen, under sides of wings and tail fulvous. The ground color therefore, is not as distinctly laid as in most, if not all, of the other forms.

Rectes aruensis is a handsome little bird of a very bright chestnut body, a crested head entirely black, and throat, breast, wings and tail the same. Under parts are of a deep tawny buff. The black on the breast is prolonged in a shield-like figure as far as the abdomen. Length, ten inches.

Rectes jobiensis has a warm reddish brown thoughout excepting where, as on the head, the coloring takes a lighter dye. The under parts are not materially different in coloration, a paler or deeper shading of the prevailing tint only being noticeable. Even the bill has the same general complexion. The female is similar to the male with the advantage of a somewhat larger size. As indicated by the specific name, *jobiensis* comes from the island of Jobie, northwest of the mainland in Geelvink Bay. He is a handsome bird like most of his kind, the erectile crest, which, however, is scarcely more than the head feathers considerably ruffled, adding to his conspicuous appearance. Not much is known of his habits or of any of the Rectes. The total length of the present species is a fraction over nine inches.

Pseudorectes, classed as a separate genus, are so like the Rectes in most respects as to make special description, if entered

upon at all, of obvious necessity. It will be sufficient here, while pointing out that the differences lie chiefly in the form of the crests, bill and, in the case of *Melanorectes* (a third genus), nasal bristles, to mention a few species and add one or two details as marks of identification. *Pseudorectes cristatus*, now placed in this genus, is noticeable for its crested head. Its general color is dull red, shading and paling on certain parts of the body, wings and tail. In size and appearance *Pseudorectes ferrugineus* is like the other species. Male and female differ imperceptibly. Above darkish brown predominates shading off or brightening on the wings and tail. Beneath is a soft buff. The bill, legs and feet dusky. *Pseudorectes leucorhynchus*, or white-bellied wood shrike, is another species with the customary coat of snuff brown, tail brighter, head darker, under parts a warm buff as far as the throat, which becomes tawny. Bill yellow. Tail nearly one-half the total length, measuring more than five inches. A synonym is *Colluricincla leucorhyncla*, sometimes classified as *Rectes*.

The third genus, *Melanorectes*, represented by the species *nigrescens*, is fairly well indicated by its name. The general color of the male is dark, black on the head, black or sooty on the under parts. Bill black, legs plumbeous. The female is ruddy and dusky brown, rejoicing in a brighter garb than her mate, although the tints are neutral rather than positive. The length is seven inches.

The *Rectes*, or to be more exact, *Rectes dichrous*, is the only bird according to Mr. Goldie, that the natives will not eat.

New Guinea contains several species and sub-species of the genus *Chibia*, the native name for the Drongo shrike, birds of from 10 to 13 inches in length, belonging to the family of the *Dicruridæ*. They are black in color with a purplish or greenish sheen, rather long, square cut tails, wings somewhat longer, both reflecting lustre more or less faint, strong, curved beaks imbedded in bristling hairs, and, in some instances, long, delicate, flexible hair-feathers on the head. It seems hardly essential to separate this genus from *Dicrurus*. In fact, most travelers in New Guinea have employed the latter name

exclusively in describing these birds, but Mr. Sharpe's decision is in favor of the first mentioned. *Chibia carbonaria* is perhaps the most common member of this genus, being met with near Port Moresby and elsewhere in New Guinea as well as on adjacent islands. It is 12 inches long, black all over, with green or purple gloss sometimes, glittering as from metal, but on the face of a velvety softness. The bill and legs are also black. A smaller form inhabiting the Aru Islands has been called *Dicrurus assimilis.*

Another variety, *Chibia megalornis,* belongs to Ke Island, to the east of Aru. Here the gloss and reflections are about the same as already recorded, with perhaps an added glint of blue and darting gleams of steel. Bead-like points show here and there on the breast as on the other species. Hackles appear on the neck of a greenish tinge. The bird is about 11 or 12 inches in length with tail about half as long.

A little bird living in Southern New Guinea, though not confined to that region, may frequently be seen flitting about among the trees in the bush, engaged in a busy search for food. This is *Collyriocincla brunnea* of the *Prionopidæ.* It is a brown and gray bird, the brown washed with gray as on the wings, becoming altogether white on the cheeks, or gray obtruded upon by brown, as along the the tail and on the crown; below a muddy tint running whitish and white on the belly and under tail-coverts. A glow of yellow shows on the under wing-coverts. The length is only between 8 and 9 inches.

Closely related to the foregoing, by some authorities regarded as of the same class, by others formed into a separate genus, are small birds termed *Pinarolestes;* little shrikes they may be called. The species *P. megarhynchus* is common enough throughout the archipelago. The prevailing color is a dark brown, streaked on the breast a deeper hue. Total length 8 inches; the female a trifle smaller.

Near Port Moresby, of recent years so well known a spot in Southern New Guinea, may be met more or less frequently a few species of the *Oriolidæ,* one of which, of the genus *Sphecotheres,* is especially noticeable. It is about the average

size of the oriole, has some bright color, though the general tone is sober, and has that bare or bald circlet around the eye which imparts a singular aspect to the face. The bird in question is *Sphecotheres salvadorii*, so named from the eminent Italian ornithologist. There is much olivaceous, becoming almost yellow around the body, running into a bluish gray about the throat and side face, white on the abdomen, yellow on the upper portion, white in wide patches on the outer tail feathers, the inner ones black, jet black on the crown as far as the staring spaces enclosing the eyes. The female is clad in dusky brown or slate mainly, mottled by darker spots on the upper surface, the under parts with running spots or irregular lines of olive or dusky over a pale yellow ground. The tail is marked similarly with that of the male, only brown takes the place of black, and dull yellow of white on some of the feathers. Clear white occurs about the vent and an open spot around the eye. Mr. Stone collected this bird as well as *Oriolus striatus*, a true oriole, common, probably, over the island. In this case the general coloration is not greatly unlike that of the female above described, with, however, a purer brown both above and beneath; but the distinctive feature of the *striatus*, as the name implies, rests in the streaks which appear almost everywhere in narrow or broader lines over the body and even monopolize the crown of the head. In fact, about the only parts free from these long black, brown or gray streaks are the wings and tail, yet these are lined off or margined with slightly different tints. The female does not show markings at variance with those of the male. The length is a good 12 inches.

Hattam Thickhead (*Pachycephalopsis hattamensis*), is a small bird about 7 inches in length, found in the mountains of Northwest New Guinea. The sexes do not differ in color or size. Back and wings are a deep olive which becomes a mere line on the wing-coverts; these are almost black. The under-wing coverts and tail are a light brown somewhat varying in shade. The head and nape of neck are gray, the lores white, as are also the chin and throat. Lower down this changes into a greenish yellow, shading off on the abdomen. Bill and feet dark.

The Blue-bodied *Eupetes—Eupetes cærulescens*—is a small thrush-like bird about 8 inches in length. D'Albertis speaks somewhat doubtfully about its habits. It runs along the ground, he says, and does not appear to perch upon the trees. Gould, however, figures it on low branches. In color it is not unlike our shrikes, although darker and more uniform, the prevailing tint being a soft bluish grey. Black is seen on the face and as a narrow rim surrounding the pure white throat. A less clear gray is spread on the under tail feathers; otherwise the gradations of the uniform steel blue are scarcely observable. The bill is sharp and black; legs and feet black. The noticeable feature of this bird is the pure white throat, the white extending well down on the breast and half way round the neck. This feature is characteristic of this fine group of birds and marks them out at once.

The Manucodes form in their several species a beautiful class of richly plumed birds, sometimes numbered with the *Paradisea*, but belonging rather to the crow family. They are however a glorified crow in their sparkling dress and imperial bearing. One of the most conspicuous for size and elegance is the Curl-crested bird of paradise, as he is sometimes styled —*Manucodia comrii*. This species is of a wondrously lustrous black throughout; it fairly blazes out with the very intensity of brightness, so that all the possible combinations which rays of light fastening upon a gleaming black surface are capable of forming, here display themselves in changing blue, violet, green, purple, etc. The dazzling effect is greatly magnified and heightened by the appearance as it were of beads and spangles of feathers upon the flat surface of the body. Upon these the reflections of light seize and glitter with a fitful radiance. To no bird, therefore, can the term sparkling be applied with as much appropriateness as to the Manucodes, Especially are these short, crisp, curl-feathers producing the strange effect abundant on the breast. In fact, they cover it, while reaching around the sides and upon the shoulders. The head, too, with its double crest of compact, thick feathers, is almost as heavily bejewelled. In addition to the short convoluted feathers, another singular

feature should not be overlooked: upon the long, heavy tail-feathers may be seen superfluous feathers, somewhat loosely laid and extending not quite the length of those below. These take the shape of the keel of a boat not unlike the tail of our crow blackbird in flight, though devoid of the trimness and elegance that marks that fine bird. The habitat is the D'Entrescasteaux group of islands. The bird has a strange, low, far-penetrating whistle. The bill and feet of the *comrii* are dull black. The bill is long and powerful. The total length of the bird is between 17 and 18 inches. The nest of this manucode has been found on the lower branch of a breadfruit tree near the end. It was composed of small vines and twigs rudely heaped together. The eggs were long and pointed and more than an inch and a half in length. Their color was buff or fawn blotched with purple dots and streaks.

Considerably smaller, but quite as brilliantly adorned is the *Green* Manucode—*Manucodia chalybea*—whose habitat is the mountains near the seacoast. Although green would seem to be the distinctive color of this species, yet the play of blue over the basal black is almost as much in evidence; both these tints are evanescent. The little recurved feathers cover the head, neck and throat and the breast as far as the abdomen. The tail is also boat shaped and reflects blue, violet, purple from a smooth surface. The back is rippled over in blue, green and lilac waves of light whenever the bird moves or the angle of vision is changed. But it is on and by means of the spangled feathers that the most exquisite effects are produced. At times they seem to dart forth light like sparks on burnt paper. The length of this manucode is about 14 inches.

Another species of Catbird besides those already mentioned is the Black-naped--*Aeluroedus melanocephalus.* The resemblance is close among the several branches of this group of birds. Here as with all the rest grass green and pale yellow are the prevailing tints. In this instance the breast, head and neck are liberally marked with black spots or streaks. White with similarly black-tipped feathers takes the place of the yellow on the

throat and cheeks. White terminates the tail feathers and is also found on the abdomen. There are spots of ochre on some of the wing feathers. The crown of the head is much dotted with black while the nape is almost entirely black. The length of this species is between 11 and 12 inches. The habitat the Astrolobe Mountains.

Mafoor Island Cuckoo-shrike—*Graucalus mafoorensis*—has a breast that is beautiful with wavy horizontal lines of white on a black ground color; these lines extend over part of the under wings. In the female the lines are broader, forming narrow stripes, thus giving the appearance of being almost equally and alternately black and white. Otherwise the bird is a soft drab color uniformly spread. Its local habitat seems to be Mafoor Island in Geelvink Bay.

A bird met with frequently along the Fly River and elsewhere in New Guinea as well as in the adjacent islands is a kind of starling—*Mino* or *Eulabes dumontii* or *Gracula dumontii*—often seen sitting on the tops of dead trees, like the Twelve-wired bird of paradise and the Wattled bird. It is about ten inches in length, stout and well built. The body is a fine black with purplish and greenish reflections strongest on the shoulders. Some gray down feathers appear on the neck; on the wings a prominent white patch but small when the bird is not in motion, is to be noted. The under tail-coverts are white sheathing the black tail. The abdomen is bright yellow, as are also the bill and feet. The eyes darker, almost brown. Around the eyes large bare spaces covered with a dull colored skin only, call particular attention to this Grakle. There are also bald spaces extending from the roots of the bill to the chin and throat. The sexes are alike. By some strange oversight in Stone's little volume, this bird is called the Golden oriole. It may be, however, that this traveler confounded Dumont's grakle with an allied genus not altogether unlike an oriole, namely *Gracula orientalis* or *Melanopyrrhus orientalis*, which is not uncommon near Port Moresby and other parts of New Guinea. This showy bird has the head of a bright rich orange. The same deep color marks the rump, lower back and upper tail-coverts. Under parts around the vent show

almost as deep a hue. All else is a glossy green-reflecting black, save a few yellow feathers near the neck. Bill, feet and eyes are light yellow. Length, 10 inches. Another species—*Melanopyrrhus* or *Gracula anais*, has less vivid orange than *orientalis*, but is marked similarly excepting on the head which instead of a rich yellow is glossy black, the bright color not appearing until a broad collar is seen round the neck and throat.

D'Albertis in his Journal describes another Mina, very scarce, which he considered new to science. The male has the "head, neck and breast of a rich orange golden color; throat and sides of the head, dark blackish green; abdomen above and below black, each feather margined with dark shining green; rump and tail-coverts deep golden orange; belly yellow, under tail-cover white tipped by a light yellow, wings and tail black, primaries white spotted, bill, eyes and feet, yellow." The traveler named the bird *Mina robersonii*.

The Chestnut-backed Eupetes—*Eupetes castanonotus*, is a small, noticeable bird found among the Astralobe Mountains in Eastern New Guinea, and in those of the northwest. The general color above is a rich chestnut. The lower back, rump and upper tail-coverts a clear blue. Wing-coverts are a bright blue with the shaft lines plainly visible. Some reddish stains tinge the scapulars while some small black feathers may also be descried. The tail is of a dull blue cast with clearer edges. The head is banded by a pale blue stripe above the eyes. Black markings diversify the face and run as a narrow rim around the pure white throat and cheeks. The under parts are a bright blue. At the termination of the under tail-feathers are broad patches of black. The length of the male bird is 9 inches. The female is somewhat smaller, differing further in having the entire upper surface chestnut without any blue. The tone is duller, however, excepting on the lower back and rump.

Beccari's Scrub Robin—*Drymoedus beccarii*—is a plain bird, distinctively Australian in character, found in the mountainous regions of New Guinea. The general color above is a lightish brown, wing-coverts ashy brown and black

barred with white. Middle tail feathers brown tipped with white. The head is of a darker brown with a spot of black beneath each eye. The cheeks and throat are a dingy white. Under parts are of a paler brown running into ashy along the sides. Under tail-coverts brown, under wing-coverts dusky tipped with wide white bars. Bill black. Feet light. Length, 7 inches.

A Moluccan Bulbul—*Criniger chloris*—is a rather long, slender bird of a shaded yellow color, about 8.5 inches in length. The head is dark, almost black, sides of the throat slightly speckled. Tail is long and broad. Bill long and black. Feet black. Iris black. Male and female alike. This graceful bird inhabits Batchian and Gilolo, falling, therefore, within the geographical limits of Papua.

Though dull in color the Naked-faced Honey-eater—*Melipotes gymnops*—is not the least interesting of the division of birds to which it belongs. Very many of the honey eaters are remarkable for their rich variegated plumage and the elegance of their forms. New Guinea contains numerous species peculiar to its own territory, while sharing with other portions of Malaysia the possession of many more. The species just noted comes from the Arfak Mountains. It is a small bird with a total length of 8.5 inches only. The prevailing color is dark brown cinereous, deepest on the back and shoulders. The face is bare and of a dingy yellow or mud color; a tint almost the same is seen on the thighs and near the vent. These are the only parts which can boast of any brightness. The abdomen and lower breast present a slightly mottled or striated appearance because of the presence of straggling light feathers over the dark slate ground color. The under tail is also of a slate color unrelieved excepting by the white quills. Bill and feet black, the former short and sharp. D'Albertis classified this honey-eater as a new genus and new species, calling it also a beautiful bird. It hardly deserves this epithet as we have seen.

Among the many Lories of New Guinea, one of the loveliest in harmonious blending of rich colors is the Red-fronted *Chalcopsitta scintillata*, Temm. It is of small size, only a foot long and of a warm, soft green plumage set off with carmine

and black. The forehead is a velvety crimson running into black on the crown. Crimson appears also on the bend of the wings, on the under side of the wings intermingled with yellow, on the thighs and on some of the tail feathers; these tail feathers, exquisitely tinted with yellow at their extremities, are rounded and overlapped in a curiously beautiful fashion. All else the color is a predominating green, frequently flushed with red or grained with yellow. Bill and feet black, eyes yellow. The sexes are not easily distinguished.

ON A NEW CLASSIFICATION OF THE LEPIDOPTERA.

By A. S. Packard.

The taxonomic importance of Walter's most interesting discovery that *Eriocephala calthella* has maxillæ constructed on the type of those of biting or mandibulate insects, *i. e.*, with an inner and outer lobe (lacinia) beside the palpi, was apparently overlooked by him as well as others, though its bearings on the phylogeny of the Lepidoptera as, however, insisted on by Walter, are, it seems to us, of the highest interest. The presence of the maxillary lobes, homologous with the galea and lacinia of the Mecoptera (Panorpidæ) and Neuroptera (Corydalus, Myrmeleon, as well as the lower orders Dermaptera, Orthoptera, Coleoptera, etc.), in what in other important respects also is the "lowest" or most primitive genus of Lepidoptera, the lacinia being a rudimentary, scarcely functional glossa or tongue, and not merely a vestigial structure, is of great significance from a phylogenetic point of view, besides affording a basis for a division of the Lepidoptera into two grand divisions or sub-orders, for which we would propose the names *Lepidoptera laciniata* and *Lepidoptera glossata.*

Sub-order I. Lepidoptera laciniata.

Walter thus writes of the first pair of maxillæ: "The other mouth-parts also of the lower Micropteryginæ have a most

primitive characteristic. In the first pair of maxillæ of *Micropteryx calthella, aruncella, anderschella* and *aureatella*, cardo and stipes are present as two clearly separate pieces. The former in *M. calthella* and *aruncella* in comparison with the latter is larger than in *anderschella* and *aureatella*. In the last two species, the cardo is still tolerably broad, but reduced. The stipes are considerably longer than the cardo in the two last species, while it is of the same thickness. From the stipes arises the large 6-jointed palpus maxillaris, folded two or three times and concealing the entire front of the head and all the mouth-parts. *At its base, and this is unique among all the Lepidoptera, two entirely separate maxillary lobes arise from the stipes. The external represents the most primitive rudiment (anlage) of a lepidopterous tongue.*" (Fig. 1.) It is evident from Walter's figures and description that this is not a case of reduction by disuse of the tongue, but that it represents the primitive condition of this lobe or the galea of the maxilla, and this is confirmed by the presence of the lacinia, a lobe of the maxilla not known to exist in any other Lepidopterous insect, it being the two galeæ which become elongated, united and highly specialized to form the so-called tongue or glossa of all Lepidoptera above the Eriocephalidæ,[1] which we may regard as the types of the *Lepidoptera laciniata.*

Another most important feature correlated with this, and not known to exist in *Lepidoptera glossata* is the presence of two lobes of the second maxillæ, besides the 3-jointed labial palpi, and which correspond to the *mala exterior* and *mala interior* of the second maxillæ of Dermaptera, Orthoptera, Platyptera, Corrodentia, *i. e.*, Perlidæ, Termitidæ and Odonata, and also, as Walter states, to the ligula and paraglossæ of Hymenoptera. In this respect, the laciniate Lepidoptera are more generalized than Neuroptera, Trichoptera, or Mecoptera.

Walter thus describes the two lobes or outer and inner mala of the second maxilla: "Within and at the base of the labial palpi is a pair of chitinous leaves provided with stiff bristles,

[1] In his paper on the larva of Eriocephala, etc. (Trans. Ent. Soc. London, 1894, p. 335), Dr. Chapman separates the old genus Micropterya into two families: *Eriocephalidæ* and *Micropterygidæ*. His group *Eriocephalidæ* I here regard as comprising the types of the sub-order *Lepidoptera laciniata* or *Protolepidoptera*.

being the external lobes of the underlip formed by the consolidation of the second pair of maxillæ, and which reach, when extended, to about the second-third of the length of the second palpal joint. Its inner edge is directly connected with the inner lobe (mala interna). The latter are coalesced into a short, wide tube, which, by the greater size of the hinder wall, opens externally on the point, also appearing as if, at the same time, cut off obliquely from within outwards.

"The outer anterior edge of the tube forms a strongly chitinous semi-circle which, becoming thinner, finally passes into the delicate membranous hinder wall. Also anteriorly a delicate membrane appears to cover the chitinous portion.

FIG. 1.

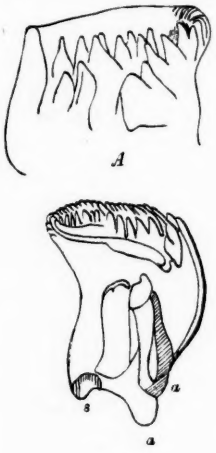


FIG. 2.

"We have here, in opposition to the weak, naked under lip represented by a triangular chitinous plate of the Lepidoptera, a true ligula formed by the coalescence of the inner lobes of the second maxillæ into a tube, as in many Hymenoptera, and with free external lobes, which correspond to the paraglossæ of Hymenoptera."

Walter has also detected a paired structure which he regards as the hypopharynx. As he states: "A portion of the inner surface of the tube-like ligula is covered by a furrow-like band

which extends close to the inner side, is coalesced with it and in position, shape, as well as its appendages or teeth on the edge may be regarded as nothing else than the hypopharynx."

While he refers to Burgess' discovery of a hypopharynx in *Danais archippus*, he remarks that this organ in the lower Micropteryginæ (Eriocephalidæ) exhibits a great similarity to the relations observable in the lower insects, adding: "The furrow is here within coalesced with the inner side of the labium, and though I see in the entire structure of the head the inner edge of the ligula-tube extended under the epipharynx as far as the mandible; I must also accept the fact that here also the hypopharynx extends to the mouth-opening, as in all other sucking insects with a full-developed under lip, viz., the Diptera and Hymenoptera."

Another feature of importance, diagnostic of this suborder, is the mandible (Fig. 2), which, in form, size and the teeth are closely related to those of the lower mandibulate orders, being, as Walter states, in the form of true gnawing jaws, like those of the biting insects. They possess powerful chitinous teeth on the opposed cutting edges, 12 to 15 on each mandible, and also the typical articulating hook-like processss by which they are joined to the gena, and corresponding cavities are in the latter. In Micropteryx and other of the more generalized moths, the mandibles in a very reduced form here survive as functionless vestiges of the condition in Eriocephala.

Turning now to the head and trunk, we find other primitive characters correlated with those just mentioned.

The head is of moderate size, as wide as the body, with small compound eyes, and with two ocelli. The occipital region is well developed, as in the epicranium; the clypeus and labrum are of moderate size.

The generalized nature of the thorax is especially noteworthy. The prothorax is seen to be very much reduced, the two tergites being separate and minute, not readily seen from above. The rest of the thorax is very long, exhibiting but little concentration.

The mesothorax is but slightly larger than the metathorax, the mesoscutum is very short, the scutellum rather triangular than scutellate.

The metathorax is but little shorter and smaller than the mesothorax, and remarkable for the widely separated halves of the scutum, a Neuropterous character (compare Ascalaphus and Corydalus) in which it differs from Micropteryx. The slope of the scutellum is that of a low, flattened triangle.

As regards the abdomen, attention should be called to the disparity in size and shape between the sexes, also to the male genital armature, which is very large and completely exserted, and reminds us of that of Corydalus, in which, however, the lateral claspers are much reduced, and also that of certain Trichoptera (Sericostoma, Tinodes, Stenophylax, Hydropsyche, etc.).

The larval characters of this sub-order it would be difficult to give, for in the remarkable larva of *Eriocephala calthella* as described and figured in Dr. Chapman's elaborate account, we appear to have a highly modified form, entirely unlike the simple apodous larva of Micropteryx, and perhaps quite unlike the primitive stem-form of Lepidopterous larvæ. We are indebted to Dr. Chapman for mounted specimens in a slide kindly given us by him. The body is broad and flattened, the segments very short in proportion to their width, the prothoracic segment, however, very long in proportion to the others, but the surface rough and corrugated, not with a hard, smooth dorsal plate as in many Tinidæ, Tortricidæ, etc., since it is not a boring insect. The eight pairs of abdominal prop-like tubercles, which we should hardly regard as homologues of the abdominal legs, are, like those of the Panorpidæ, simple tubercles armed with a curved spine. The tenth or last abdominal segment is armed with a pair of dorsal spines, arising from a tubercle. The singular flattened and fluted setæ represented by Chapman are unique in Lepidopterous larvæ. He also describes a trefoil-shaped sucker on the under side of the ninth and tenth abdominal segments, "very unusual;" though as it appears to be paired, it does not, as Chapman thinks, seem to us to indicate "a further point of relationship to Limacodids."

Chapman states that "the head is retractile, so far, that it may occupy the interior of the second thoracic segment," and he says that "the antennæ are remarkably long for a

Lepidopterous larva." He remarks that there are "two strong mandibles, with four brown teeth," and adds: "two pairs of palpi are also visible—two- and three-jointed, apparently those usual in Lepidopterous larvæ, but I have not defined their relations. There is also a central point (spinneret?)"

I add rough sketches of the mouth parts, so far as I could draw them with the camera from specimens mounted in balsam by Dr. Chapman. The labrum (Fig. 3, *lbr.*) is less divided than usual in Lepidopterous larvæ, but is not, in this respect, much unlike that of Tineids *e.g.* Gracilaria (see Dimmock's Fig. 2, p. 100, Psyche, iii). The four-jointed antennæ (Fig. 3A *ant.*), ending in two unequal setæ, are of very unusual

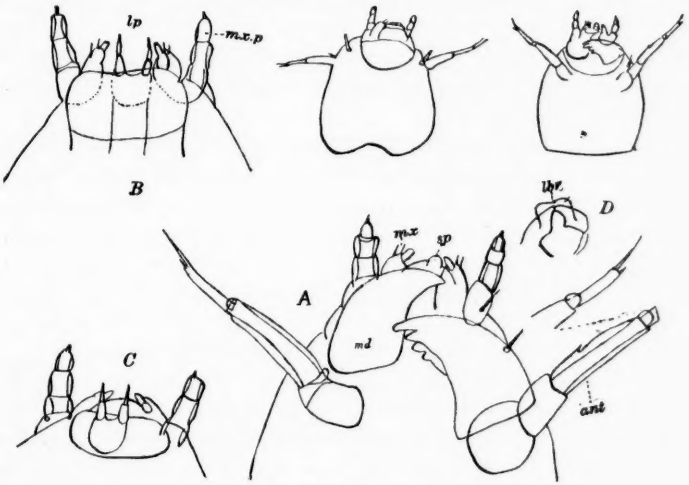


FIG. 3.

size and length, and so are the maxillary palpi (Fig. 3B *mx.p.*) which are much larger than in any caterpillar known to me, and greatly in disproportion to the maxillary lobes; the maxillary itself differs notably from that of other caterpillars; what appears to be the lacinia is palpiform and two-jointed. The labium and its palpi are much as in Gracilaria, but appear to be three-jointed, with a terminal bristle (it is possible that there are but two joints). Unlike the larva of Micro-

pteryx, that of Eriocephala does not appear to possess a well-marked spinneret; while it is easy to see it in the former genus, in Eriocephala I can only detect a lobe which appears to be simply the rudiment (*anlage*) of a spinneret (unless the latter is in my specimen bent under the head); but this organ needs further examination on fresh specimens. It would be interesting if it should be found that the spinneret is in a generalized or germinal condition, as compared with that of Micropteryx.

The pupa.—Unfortunately, we are, as yet, ignorant of the pupa form. Dr. Chapman has only found the head-piece of the pupa, but refers it to the "Incompletæ," and thinks it probable that the pupa has the "third and following abominal segments free"

The eggs.—The egg, according to Chapman, is "large and spherical," and laid in confinement in little groups, to the number of twenty-five in all.

Diagnostic characters of the Lepidoptera laciniata.—I add the characters of this sub-order. Imago. Maxilla with a well-developed lacinita and galea, arising as in mandibulate insects from a definite stipes and cardo, the galea not elongated, united and differentiated into a glossa, each galea being separate from its fellow, and the two not acting as a "tongue." The maxillary palpi enormous, six-jointed. Mandibles large, scarcely vestigial, with a broad, toothed cutting-edge, and with them apparently functional hinge-processes at the base, as usual in mandibulate insects. Hypopharynx well-developed, somewhat as in Diptera and Hymenoptera; second maxilla divided into a mala exterior, and a mala interior, recalling those of mandibulate insects; palpi three-jointed. Thorax and prothorax very much reduced; metathorax very large, with the two halves of the scutum widely separate.

Venation highly generalized; both fore and hind wings with external lobe or a "jugum" as in Trichoptera, veins as in Micropteryx and showing no notable distinctions compared with those of Micropteryx; scales generalized; fine scattered setæ present on costal edge and on the veins. Abdomen elongate, with the male genital armature neuropteroid, exserted, the dorsal, lateral and sternal appendages very large.

Eggs spherical. Larva, in form, highly modified, compared with that of Micropteryx, with large, four-jointed antennæ and very large three-jointed maxillary palpi; no spinneret? No abdominal legs, their place supplied by a pair of tubercles ending in a curved spine on segments 1–8; a sternal sucker at the end of the body. Pupa libera?

Sub-order II. LEPIDOPTERA HAUSTELLATA.[2]

This group may be defined thus: Maxillæ with no lacinia, the galeæ being highly specialized and united with each other to form a true tubular haustellum or glossa, coiled up between the labial palpi. The maxillary palpi large and fine or six-jointed in the more generalized forms, usually vestigial or entirely wanting in the more modern specialized families. Mandibles absent, as a rule, only minute vestiges occurring in the more generalized forms. Wings both jugate and frenulate, but mostly the latter, tending to become broad and with highly specialized scales, often ornamented with spots as well as bars, the colors and ornamentation often highly specialized; the thorax highly concentrated, the metathorax becoming more and more reduced and fused with the mesothorax; the abdomen in the generalized forms elongated, and with large exserted male genital armature.

Pupa incomplete, the abdominal segments 3 to 6 or 7 free, in the more generalized primitive forms, the end of the maxillary palpi forming a visible sub-ocular piece or "eye collar;" or a flap-like piece on the outside of the maxillæ; the labial palpi often visible; clypeus and labrum distinct; paraclypeal pieces distinct; no cremaster or only a rudimentary one in the generalized primitive forms.

Larva with usually a prothoracic or dorsal chitinous plate; the armature consisting, in the primitve forms, of minute one-haired tubercles, the four dorsal ones in a trapezoid on abdominal segments 1–8, becoming specialized in various ways in the later families into fleshy tubercles, or spines of various shapes. Five pairs of abdominal legs, with hooklets or crochets forming

[2] If the term *haustellata* should be thought inapplicable from its frequent use by former authors, the term *Lepidoptera glossata* could be used instead.

a complete circle in the more generalized forms (in Hepialidæ several complete circles), the hooklets in the latter more specialized groups, usually forming a semicircle situated on the inner side of the planta.

This sub-order may be sub-divided into two series of superfamilies and families, the *Paleolepidoptera* and the *Neolepidoptera.*

I. Paleolepidoptera (*Pupæ liberæ*).

The characters of this group are those of Micropteryx, whose larva has a well-developed spinneret; though it has no abdominal legs, the other features are so truly lepidopterous that the absence of legs may be the result of reduction by disease, rather than a primitive feature.

The pupa (Fig. 4) has entirely free antennæ, mouth-parts and limbs, and bears considerable resemblance to that of a caddis-fly. The mandibles are enormous, and, as described by Chapman, are adapted for cutting through the dense coccoon. The maxillæ are separate and curved up on each side and partly concealed by the labial palpi, not extending straight down as in the *Pupæ incompletæ* and *obtectæ;* the maxillary palpi situated just in front of the mandibles extend outward and forward, reaching to the antennæ. The labrum is deeply cleft and strongly setose, as is the epicranium; the clypeus is square, with a singular, white, delicate membrane, the use of which is unknown. The hind legs extend beyond the end of the abdomen, which is simple, not terminating in a cremaster; the sides of the segments bear a single large seta.

The trunk characters are much as in Eriocephala. The head is larger and squarer, the eyes very small; there are two ocelli present; the clypeus and labrum short and small.

The prothorax is very much reduced, much as in Eriocephala; the metathoracic scuta show an advance over those of Eriocephala in being united on the median line instead of separated; the metoscutellum is very large, larger and more scutellate than that of Eriocephala.

The shape and venation of the wings (Fig. 5) are nearly identical with those of Eriocephala, being long, narrow and

pointed, both pairs nearly alike in size and venation, except that on the hinder pair there is a "jugum" or angular fold: scales are of generalized shape all over the wing. The pres-

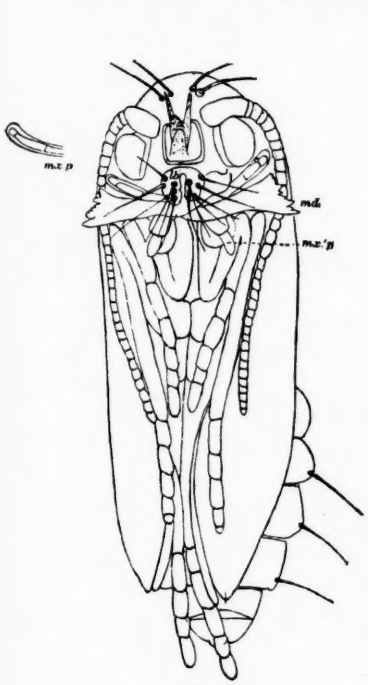


FIG. 4.

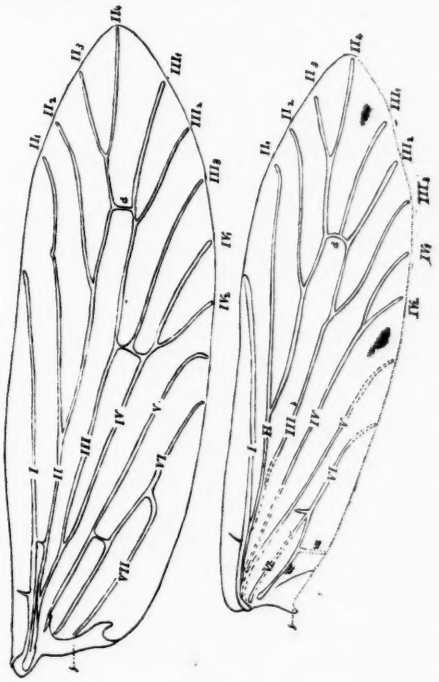


FIG. 5.

ence of a jugum on both pairs of wings is significant, since in Trichoptera, they are also present in both pairs of wings.

II. NEOLEPIDOPTERA.

This series may be divided into two sections, corresponding in the main to the *Pupæ incompletæ* of Chapman (the Eriocephalidæ and Micropterygidæ included by Chapman being removed), and his *Pupæ obtectæ*, for the first of which we would suggest the name *Tineoids*, and for the second, the large broad-winged forms or Macrolepidoptera or Platylepidoptera.

Tineoids or *Stenopterygia.*

These are Tineoid forms with many vestiges of archaic features, usually with narrow wings, of dull hues or with metallic bars, or with highly specialized shapes of scales and spots, and the venation generalized in the earlier forms. The maxillæ are sometimes aborted (wholly so in Hepialidæ); maxillary palpi either well-developed, more or less reduced, or wanting; mandibles rarely occurring as minute vestiges; the thorax neuropteroid in the more primitive forms becoming shorter and the segments fused together in the later or more specialized groups.

The pupæ are incomplete; the more primitive forms with the eye-collar and labial palpi visible; paraclypeal pieces distinct; abdomen often with no cremaster in the most primitive forms.

Larvæ with one-haired tubercles, the four dorsal ones arranged in a trapezoid on abdominal segments 1–8; usually a prothoracic dorsal plate; the abdominal legs sometimes wanting in certain mining forms (and Cochliopodidæ); larvæ often case-bearers or borers; crochets on the abdominal legs in the primitive types arranged in two or more complete circles; in the lowest forms a well-marked spinneret.

Remarks on the Tineina.—It must now be very obvious that we need to re-examine and revise the Tineina, and especially their pupæ and imagines, particularly those of the more generalized forms, such as the Tineidæ (Tinea and Blabophanes), and the Talæporidæ, comprising all those ancestral forms with broad wings and a generalized venation which may have given rise to the neolepidopterous families.

Then careful studies should be made on the Adelidæ, Choreutidæ and Nepticulidæ, and other families and genera in which the mandibles have persisted (though in a vestigial condition), and also those with functional or vestigial maxillary palpi, such as Tineidæ, Gracilariidæ, Elachistidæ, etc.

It is evident that the classification of the Tineina will have to be entirely recast; instead of placing the Tineidæ, with their broad wings and generalized venation at the head of the Tineina as done in our catalogues and general works, they should go to the base of the series, not far from the Microptery-

gidæ. On looking over the venation of the Tineidæ represented on Spuler's Plate XXVI, it is evident that the very narrow-winged genera, such as Coleophora, Ornix, Lithocolletis, Nepticula, Gelechia, Cemiostoma and Œcophora, are highly modified recent forms, when compared with Tinea and Blabophanes as well as the Adelidæ (Adela, Nemotois, Choreutidæ, Simaethis and Choreutis) and justify Chapman in associating them with the Pyraloids in his group of *Pupæ obtectæ.*

Family *Prodoxidæ.*—This group is represented by Tegeticula (Pronuba) and Prodoxus. The eye-collar (maxillary palpi, Fig. 6, *mx p*) is larger than in any of the other Tineina, and the group is thus intermediate between the Neo- and Paleolepidoptera. The pupa, as well as other stages, have been well-described by Riley, who, however, has overlooked the eye-collar, though he figures and describes the remarkable "maxillary tentacles." I am disposed to regard the latter organ as the maxilla itself, and to consider that the "maxilla" of Riley is the lacinia or inner lobe of the maxilla, but have had no material for examination. Should this prove to be the case, it would carry the family down among the *Lepidoptera laciniata.*

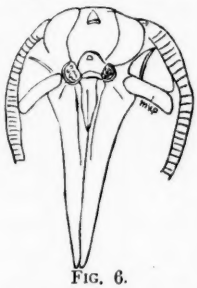


FIG. 6.

(*To be continued.*)

RECENT LITERATURE.

Some Recent Text-books and Student Guides.—For several years the crying need of American teachers has been a text-book of zoology which, in contents and manner of treatment, should be of use in American colleges and technical schools. All that our publishers had offered us were books which were far behind the times, and some were far behind any times unless we go back to that long ago when

father Adam was posing as a systematist and was giving the animals their names. So the American student has had to depend on European works. Sedgwick's translation of Claus, notwithstanding its outrageously high price and its short comings in treating of the vertebrates has been used extensively. With Dr. McMurrich's Invertebrate Morphology[1] the demand is partially met—partially since the work deals only with the Invertebrates. Now the American teacher can refer his students to a brief and yet modern account of those animals fortunate enough to lack back bones, with the assurance that they will find, clearly expressed, the essential facts of structure and development. In his general treatment Dr. McMurrich follows the time honored precedent, first dealing with protoplasm and the cell, next with the Protozoa and the passing to the Metazoa and their various subdivisions. In these the sponges are retained under the Cœlenterata (spelled Cœlentera) while, rightly we think, the Ctenophores are regarded as a distinct branch. A bit of conservatism retains the Nemertines in the flat worms, and the close association of the Sipunculids and Gephyrea. Like von Kennel, one author disregards the Arthropods, presenting instead three "types" Crustacea, Arachnida, and Tracheata, and (*pace* Lankester) treating the Xiphosures as an appendix to the Crustacea.

In his general treatment the author exhibits a familiarity with recent literature and discusses at some length such morphological questions as the origin of metamerism, the iner-relationship of arthropods, affinities of the Mollusca, etc. The illustrations are largely process cuts and while they have, in most instances, a freshness which is pleasing there is not infrequently an exasperating inaccuracy or vagueness in many of the diagrams and copies. Thus the student puzzling over the oviduct of the barnacle will have no assistance as to its termination from fig. 181, while one looking for the number of cardiac ostia in Limulus will be misled by fig. 196. But the most serious errror which we have noticed relates to Peripatus. In fig. 220, which is copied from Sedgwick, the term cœlom is extended to all the cavities of the body which Sedgwick shows are pseudocœliac, and the peculiar feature that the true cœlom is *restricted* to the gonads, the sac at the inner ends of the nephridia, and the nephridia and genital ducts is no where noticed in the text. The typography and press-work of the volume are good and we are glad to see that the publishers have dropped the fat

[1] A text-book of Invertebrate Morphology by James Playfair McMurrich. New York. Henry Holt & Co., 1894 80 pp. vii+660.

and dumpy style in which they issued the earlier volumes of the "American Science Series."

At last there is a convenient work on the anatomy of the cat;[2] a work which is devoted to the cat and the cat alone; which does not discuss foreordination or total depravity, Grimm's law or the price of stocks; which tells the student plainly how to cut up the useful laboratory animal, tells the names of the various parts, and gets through when it is through. The little work of Messrs. Tower and Cutter is handy in size, clear in directions and intelligible in its figures and diagrams. It is the book we long have sought aud mourned because we found it not.

Comstock's Manual for the Study of Insects.[3]—For several years teachers and students of entomology have been waiting in eager anticipation for the completion of the work upon which Professor and Mrs. Comstock have so long been engaged. Now that it has appeared they have no reason to regret the delay, for the book is by far the best manual available to the student. It contains 700 pages, 800 figures on the text and six full page plates, one of which is colored. Practically all of the illustrations are original with the authors, the great majority of them having been especially engraved for this book by Mrs. Comstock. These figures for the most part are of unusual excellence, and the plates, especially IV, V and VI are of rare artistic value, and in my judgment are the finest examples of insect illustrations in black and white that have appeared in America. Any entomologist would be glad to frame these for his study or laboratory, and it is to be hoped that the publishers will see fit to print these plates on large paper for this purpose.

In the preface the authors state that the book has been prepared especially with reference to the needs of the student who desires to determine "the names and relation affinities of insects, in some such way as plants are classified in the well-known manuals of botany." It has been possible to carry out this idea only with the larger groups, the number of species precluding the possibility of making keys to species. The keys go far enough, however, to be of great value to the teachers and student.

Nineteen orders of insects are recognized, in the following sequence —Thysanura, Ephemerida, Odonata, Plecoptera, Isopoda, Corrodentia,

[2] A laboratory guide for the dissection of the cat by Frederic P. Gorham and Ralph W. Tower. New York, Chas. Scribners Sons, 1895, pp. ix+87.

[3] A Manual for the Study of Insects by J. H. and A. B. Comstock. Ithaca, N. Y. Comstock Publishing Co., 1895. Price $3.75.

Mallophaga, Dermaptera, Orthoptera, Physopoda, Hemiptera, Neuroptera, Mecaptera, Trichoptera, Lepidoptera, Diptera, Siphonaptera, Coleoptera, Hymenoptera. The first chapter is devoted to zoological classification and nomenclature, and the second to the near relatives of the insects—crustaceans, scorpions, spiders, mites and myriapods. In the third chapter appears a general discussion of the characteristics of the class Hexapoda, together with a table for determining the orders of insects. Then follow nineteen chapters, each devoted to one order of insects.

The Manual must prove for many years to come the *sine qua non* of the student of American insects. The authors are to be congratulated upon the happy completion of so many years of earnest work, and entomological teachers will be heartily glad to be able to give a satisfactory answer to the query so often asked regarding a text-book for those desiring to take up the study of insects. The accompanying plate shows samples of the engravings in the book.—CLARENCE M. WEED.

In Bird Land.[4]—In this little volume Mr. Keyser has recorded a series of observations made on the birds about Springfield, Ohio. A rare descriptive power combined with a warm love for the feathered tribes makes the writer a most delightful depicter of scenes in bird life. Domestic and social habits, out-of-the-ordinary conduct, their schemes for making a living and a variety of other interesting bits of information, the result of the author's personal gleaming in field and forest, at all seasons of the year, are discussed in an easy, colloquial style that is extremely entertaining.

A list of birds seen in the vicinity of Springfield during the year, numbering 134 species is given in the appendix.

RECENT BOOKS AND PAMPHLETS.

Annual Report of the Curator of the Museum of Comparative Zoology at Harvard College to the President and Fellows of Harvard College for 1893-94.

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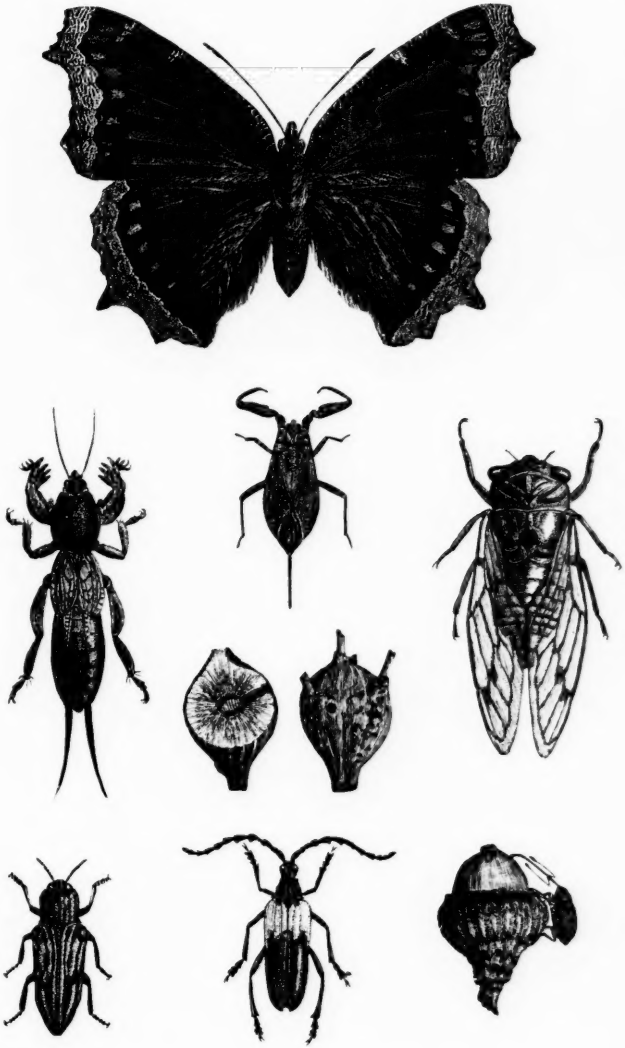
[4] In Bird Land. By L. S. Keyser, Chicago, 1894. A. C. McClurg & Co. Publishers.

PLATE XXVIII.



ENGRAVINGS OF INSECTS

FROM COMSTOCK'S MANUAL

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COBB, N. A.—Host and Habitat Index of the Australian Fungi. Misc. Pub. No. 16, Dept. Agric. New South Wales. From the author.

Contributions from the Geological Department of Columbia College, Vol. III, Nos. 14-23, 1893-94. From the College.

DUBOIS, E.—*Pithecanthropus erectus*, eine Menschenaehnliche Uebergangsform aus Java. Batavia, 1894. From the author.

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HERRERA, A. L.—El clima Dell Valle de México y la Biologia de los Vertebrados. Extr. La Naturaleza, 2d series. Tomo II.

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General Notes.

MINERALOGY.[1]

Vicinal Planes and the Variation of Crystal Angles.—Miers[2] has measured by means of a specially constructed goniometer[3] the changes in the form of crystals during their growth. Potash and ammonium alum is a substance whose apparently octahedral crystals are subject to noticeable variations in the size of the octahedral angle, and whose faces are sometimes vicinal in character. Miers began an investigation to determine whether the angles subject to variation have different values at different stages in the growth of the crystal, and if so, whether the faces change their inclination during growth, provided the crystal is held fixed. He has made the following important observations:

(1.) The faces of the regular octahedron are never developed on alum growing from aqueous solution.

(2.) The reflecting planes (which are often very perfect) are those of a very flat triangular pyramid (trisoctahedron).

(3.) The three faces of this triangular pyramid may be very unequal in size.

(4.) The trisoctahedron which replaces one octahedral face of a crystal may be different from that which replaces another face of the same crystal.

(5) During the growth of the crystal the reflecting planes change their mutual inclinations; the trisoctahedron becomes in general more acute, i. e., deviates more from the octahedron which it replaces as the crystal grows.

(6.) This change takes place, not continuously, but *per saltum*, each reflecting plane becoming replaced by another which is inclined to it by a small angle (generally about three minutes).

(7.) During growth the faces are always those of trisoctahedrons; but, if for any reason, as rise of temperature, re-solution occurs, icositetrahedrons are developed.

[1] Edited by Dr. Wm. H. Hobbs, University of Wisconsin, Madison, Wis.

[2] Abstract of paper read before the British Association. Nature, **50** pp. 411–412. (August 23d, 1894.)

[3] See these notes, March, 1895.

Thus it is shown that, in this case at least, crystals do not grow by the deposition of parallel layers of substance, but that new faces are constantly being developed which obey the law of rational (though not simple) indices. Their mutual inclinations in the case of alum show that the face to which they approximate is always the octahedron with angle 70° 31¾′, hence the faces of this form do not vary their inclination as supposed.

Determination of the Principal Indices of Refraction for the most Important Rock-making Minerals.—Zimanyi[4] has determined by the method of total reflection (using a modified Kohlrausch total reflectometer) the principal indices of refraction, and hence, at the same time, the double refraction, of the more important rock-making minerals. He has found that methylene iodide, which has not before been used with the total reflectometer, is a particularly good enclosing medium, since it was found to suffer scarcely any change in the course of an entire year. His paper gives the results of a very extensive series of determinations on no less than fifty-five species or varieties. A few of the determined values are given below:

Mineral.	*Mean index of refr.*	*Double refr.*	*Opt. Char.*
Albite (Schmirn).	1.5337	0.0105	+
Elæolite (Laurvik).	1.5350	0.0042	—
Nepheline (Vesuvius).	1.5407	0.0050	—
Orthoclase.	1.5222	0.0064	—
Sodalite (Ditro)	1.4834		
Nosean (Laach).	1.4950		
Hauyne (Latium).	1.5027		
Leucite (Vesuvius).	1.5086		
Cordierite (Bodenmais).	1.5396	0.0091	—
Muscovite (Buckfield).	1.5861	0.0388	—
Augite (Pojana).	1.7000	0.0250	—?
Biotite (Diff. localities).	1.5600–1.5894		
Tremolite (Diff. localities).	1.6117–1.6135	0.0252–0.0270	—
Actinolite (Diff. localities).	1.6150–1.6257	0.0271–0.0280	—
Tourmaline (Diff. loc.)	1.6324–1.6357	0.0184–0.0239	—
Amphibole (Kafveltorp).	1.6463	0.0163	+
Sillimanite (Saybrook).	1.6641	0.0200	+
Olivine.	1.6710	0.0359	+
Zoisite (Tyrol).	1.7010	0.0050	+

[4] Zeitsch. f. Kryst, XXII, pp. 321–358 (1894).

New Minerals.—Igelstrom[5] describes several supposed new minerals from Sjögrube, Gouv. Orebro, Sweden, which are either massive or so poorly crystallized that their symmetry could not be definitely determined. Their names and supposed compositions are as follows:

Lamprostibian.—A qualitative analysis showed the presence of much Sb_2O_5 and FeO, with smaller amounts of MnO, As_2O_5, PbO, "and other substances;" from which the mineral is supposed to be an antimonate of iron and manganese.

Elfstorpite.—A qualitative determination yielded much H_2O, As_2O_3 and MnO, with traces of CaO and MgO, hence the mineral is supposed to be a very hydrous arsenate of manganese.

Chlorarsenian.—Anhydrous arsenate of manganese (from qualitative tests).

Rhodoarsenian.—Analysis furnished the following formula:

$(10\ RO\ As_2O_5)+10\ (RO\ H_2O)$ in which R=Mn, Ca, and Mg.

Basiliite.—$(Mn_2O_3)_4\ Sb_2O_5+7\ Mn_2O_3.\ 3\ H_2O.$

Sjögrufvite.—$2\ (RO)_3\ As_2O_5+Fe_2O_3.\ As_2O_5+6\ H_2O$, in which R=Mn, Ca, and Pb.

Doelter, The Characters of Gems.—Eight years ago Groth issued a very interesting popular introduction to the study of gems, intended for the general public and also in a special way to inform jewelers of the delicate mineralogical methods which may be made use of by them for the determination of stones.[6] Great stress was laid upon the optical method of investigation, and a special microscope was designed and constructed for the use of jewelers. Doelter[7] has recently published a more pretentious work, and one of a somewhat more practical character. The book is essentially a manual and includes some 260 pages. It contains a great deal of matter and this is very well arranged. Doelter shows that in spite of the delicate nature of the optical methods, they can only rarely be applied on cut gems. The specific gravity test, particularly when heavy solutions are used, is the most delicate test, and also the one most easily applied. In addition, the examination with the dichroscope, and chemical and hardness tests, are applied in some cases. The artificial reproduction of the different gems in the laboratory, and the technical methods of imitat-

[5] Zeitsch. f. Kryst., XXII, pp. 467–472 (1894).

[6] Grundriss der Edelsteinkunde, Engelmann, Leipzig, 1887.

[7] Edelsteinkunde, Bestimmung und Unterscheidung der Edelsteine und Schmucksteine, die künstliche Darstellung der Edelsteine, von Dr. C. Doelter. Veit & Comp., Leipzig, 1893.

ing the valuable gems are given in detail. The greater part of the work is devoted to the detailed descriptions of the individual types of stones. In the third part of the work is given a systematic method of examining a stone, with a key for use in the determination. A chapter is devoted to the means of identifying the various imitations in use in the trade. A list of 250 trade names of gems, with the scientific name of the mineral and the group in which it belongs in parallel columns, will prove of great value for reference.—W. H. HOBBS.

PETROGRAPHY.[1]

Rock Differentiation.—Harker[2] contributes an interesting article on rock differentiation in his study of the gabbro of Carrock Fell, England. The hill in question consists of bedded basic lavas, gabbro, granophyre and diabase in the order of their intrusion. The gabbro is of especial interest, since it presents a simple example of rock differentiation. In its center the mass is quartziferous. Toward the periphery it passes gradually into an ordinary gabbro, and immediately upon the border into an aggregate composed largely of titaniferous magnetite. In explaining the causes of this gradual transition in chemical and mineral composition, the author discards the theories usually proposed to explain similar phenomena, and concludes that, in the case under discussion, the separation of the magma into its parts took place during the period of crystallization by concentration of the crystallizing substances. The concentration is greatest for those minerals belonging to the earliest stages of the rock's history, hence it is thought that the differentiation took place by diffusion in a fluid magma, and that in those parts of this magma richest in basic minerals crystallization first occurred. As the crystals separated, the supply of the crystallizing substance was kept up by diffusion from other portions of the magma into the basic portions.

Another interesting feature of the gabbro mass relates to the contact effects produced by the rock in the surrounding basic lavas, some of which are enclosed as fragments in the midst of the gabbro. Their isotropic base has crystallized, and some changes have been produced

[1] Edited by Dr. W. S. Bayley, Colby University, Waterville, Maine.

[2] Quart. Journal Geol. Soc., 1894, p. 311.

in the composition and structure of their phenocysts. At the immediate contacts of the different rocks a commingling of their materials seems to have taken place. Mica has been generated in the gabbro, and the groundmass of the lavas has disappeared, leaving a plexus of small feldspar laths imbedded in a clear mosaic of quartz or of quartz and feldspar.

The Metamorphism of Inclusions in Volcanic Rocks.—In a memoir presented to the French Academy of Sciences, Lacroix[3] gives a very full resumé of the conclusions reached by him in the study of the action of modern volcanic rocks on the inclusions imbedded in them. The conclusions are based on the results of late studies as well as on those reached several years ago.[4] The author finds that the basaltic and the feldspathic effusives act differently toward foreign fragments imbedded in them. The former act principally through their high temperature, fusing the most easily melted components of the inclusions, while the trachytic rocks act more effectively in producing mineralogical changes through the aid of the mineralizers, mainly water, with which they are abundantly provided. The physical and chemical changes suffered by the material of the inclusions are discussed separately and fully. Often the fragments in the basalts are reduced by fusion to a few grains of their most resistant components, while the fragments in the trachytes have lost only their micaceous constituents by fusion. Consequently the metamorphism in the latter cases is supposed to have been produced at a comparatively low temperature, although the new minerals produced in number exceed by far those produced in the basaltic inclusions at a much higher temperature. With respect to the effects produced on rocks in situ, it is found that basaltic and trachytic lavas act alike—mainly through their heat. The metamorphic action in both cases is comparatively slight. The similarity in the effects produced by the two types of lavas in this case, when compared with the dissimilar effects produced upon their inclusions, is explained as a consequence of the fact that all lavas, when they reach the surface, lose their volatile constitutents, and so, of necessity, can affect alteration in contiguous rock masses solely by means of their high temperature. In other words, the alteration of inclusions is effected at a depth beneath the surface, while the alteration of rocks in situ is a surface phenomenon.

[3] Mèmoires présentés à l'Acad. d. Sciences de l'Institut de France, xxxi.

[4] See American Naturalist, 1894, p. 946.

The Petrography of Aegina and Methana.——The lavas of the island of Aegina and the peninsula Methana in Greece are andesites and dacites that have broken through cretaceous and tertiary limestones. Washington[5] separates the rocks into the two groups above-mentioned on the basis of the SiO_2 contents. Rocks containing above 62% of SiO_2 he classes as dacites, those containing less than this amount as andesites. The dacites are divided into hornblende, hornblende-hypersthene and biotite varieties, and the andesites into hornblende, biotite-hornblende, hornblende-augite, hypersthene and hornblende-hypersthene varieties. All the rocks are more or less porphyritic, and all contain more or less glass. Tridymite is present in the hornblende andesites from the Stavro district. The trachyte described by Lepsius from near Poros is a biotite-hornblende-andesite. Brown and green hornblendes are both present in the Grecian rocks, but not in the same specimens. The green variety is characteristic of the pyroxene free andesites, and the brown variety of those rocks containing an almost colorless pyroxene as one of its essential components. This association of the two hornblendes indicates that their formation is dependent upon differences in chemical composition of the magmas from which they separated, as well as upon the conditions under which their separation took place.

In almost all of these rocks there are segregations of the same composition as that of the enclosing rocks, except that they are more basic. Two classes of segregations are observed. The first are hornblende-augite-andesites, containing brown hornblende and no glass; the second class is composed of green hornblende in a glassy base with plagioclase laths. The brown hornblendes are often changed to opacite, surrounded by a zone of colorless crystals of augite. In those segregations in which the hornblende is of the green variety, no such alteration is observable. The glass in these segregations is so different from that of the rock in which they occur, that it cannot be regarded as portions of the latter. The author is inclined to regard these bodies as fragments of earlier lava flows buried deeply beneath the latter ones.

In his discussion on the general relations of the different rocks of the region, the author states that "in general * * * the more acid the rock the more vitreous the groundmass, the smaller and more microlitic the crystals in it, and the larger and more abundant the phenocysts."

After remarks on the chemical relations of the different rock types to each other, and a discussion of the Aegina-Nisyros region as a

[5] Jour. of Geology, Vol. II, p. 789, and Vol. III, p. 21.

"petrographical province," the paper closes with the statement that although the lavas of the region under discussion are so similar to those of the Andes, nevertheless, the original undifferentiated magmas of the two districts were quite dissimilar.

Maryland Granites.—The granite and associated rocks on the east side of the Susquehanna River in Cecil County, Maryland, have been made the subject of study by Grimsley.[6] In the northern portion of the area investigated, the granite is but little sheared, while in its southern portion the rock is very gneissic. The two portions of the area are separated from each other by a band of staurolite-schist. Though the rocks of both areas were originally the same in composition, it is thought that the northern granite may be the younger, since it is intruded by dykes of what appears to be a dynamically metamorphosed gabbro, while, on the other hand, the southern granite intrudes a basic rock that apparently grades into gabbro. Both granites are biotitic varieties, and both are eruptive in origin. The northern granite is remarkable for the epidotization of its feldspar, which is predominantly plagioclastic, and for the occurrence in it of numerous dark basic segregations. Many rare minerals, such as zircon, magnetite, tourmaline, cubical garnets and sphene were found in large quantities in the soil produced by its decomposition. The northern contact of the northern granite is somewhat abnormal in its characters. The granite appears to become more basic toward the contact, and the basic phases are cut by apophyses of the normal acid rock.

An analyses of the granite follows:

SiO_2	TiO_2	Al_2O_3	Fe_2O_3	Feo	MnO	CaO	SrO	BaO	MgO	Na_2O	Li_2O	H_2O	P_2O_5	Total
66.68	.50	14.93	1.58	3.23	.10	4.89	tr.	.08	2.19	2.65	tr.	1.25	.10	= 100.32

Alabama Cherts.—Hovey[7] has recently examined a series of cherts sent him from Alabama. Those from the Lower Magnesian series consist almost entirely of chalcedony, with the addition of a little quartz and opal. The rocks are fine-grained mosaics that are mottled by reason of variations in the fineness of their grains. The quartz appears to be secondary, as it fills cavities in the chalcedony. A few scales of limonites and dust particles are present in almost all sections. No well-defined organic remains were detected in any. The cherts from the Lower Carboniferous, on the other hand, contain numerous

[6] Jour. Cin. Soc. Nat. Hist., Apr.–July, 1894.

[7] Amer. Jour. Sci., 1894, xlviii, p. 401.

remains of calcareous organisms, which are cemented together by chalcedony exhibiting a tendency to form concretionary granules. In some specimens, genuine spherocrystals of this mineral were detected. Chemical analysis of both classes of cherts show the absence of opal. The author regards the rocks as chemical precipitates.

GEOLOGY AND PALEONTOLOGY.

The Californian Coast.—A. G. Lawson presents the following as the sequence of events which have led to the present topography of the Coast of California north of the Golden Gate:

I. A development in Pliocene time of a great coastal peneplain with correlative accumulation of marine sediments.

II. The orogenic deformation of parts of this peneplain and folding of the Pliocene strata.

III. The reduction of the soft upturned Pliocene strata to base level.

IV. The progressive uplift of this peneplain to an elevation of from 1600 to 2100 feet above sea land, the adjacent mountainous tracts participating in the same movement.

V. The advance in the new geomorphic cycle to a stage of early maturity.

VI. A very recent depression of about 100 miles of the coast adjacent to the Golden Gate, and the consequent flooding of the stream valleys by the ocean.

This history is in harmony with the disastrophic record of the coast south of the Golden Gate presented by Mr. Lawson in a former paper. (Bull. Univ., Cal., Vol. I., 1894).

Disintegration of Granite.—Of the agencies concerned in the disintegration of the granite rocks in the District of Columbia, U. S., Mr. G. P. Merrill considers hydration the most pronounced and universal in its effects. During an examination of material from the region under discussion, both granite and dioritic rocks with smooth even faces taken from depths of a hundred feet or more were examined, and many, which under casual inspection showed no signs of decomposition, were found to disintegrate rapidly into coarse sand after a short exposure to the atmosphere. The author's explanation of this behavior is that the minerals composing the rocks (with the exception

of the quartz) underwent partial hydration, but, held in the vise-like grip of the surrounding rock, were unable to expand to the full extent of loss of cohesion. When freed from compression, expansion and further hydration took place, the mass became spongy, and, freely absorbing water, fell into sand and gravel. This idea led to a series of experiments, and from an average of several determinations, Mr. Merrill obtained an approximation of 1.88, which represents the degree of expansion which the rock undergoes in passing from its fresh condition into that of undisturbed soil a foot beneath the surface. (Bull. Geol. Soc. Am., Vol. 6, 1895).

Dolomites of the Northwestern States.—The Magnesian series distributed through southern Wisconsin and Minnesota, extending into northwestern Iowa have been studied by C. W. Hall and F. W. Sardeson. From paleotological evidence the authors divide the series into four alternating formations of dolomites and sandstones belonging to the Upper Cambrian and a fifth of dolomite which may be considered a part of the Ordovician.

As to the origin of the dolomites, the authors do not commit themselves to any theory, but point out that the porous condition of the dolomite and the freedom of the sandstones and arenaceous shales of the series from the several impurities so universal in recent rocks of this character suggest that the original rock mass, which was a limestone of the same constitution as those now forming within ocean areas —that is, a carbonate of lime with a percentage of magnesium carbonate—has become dolomitic through the removal of the calcium carbonate. (Bull. Geol. Soc. Am., Vol. 6, 1895.)

The Silver Mines of Lake Valley, New Mexico.—These mines are situated about six miles from the old Sante Fé trail, and fifteen miles from the Rio Grande. The ore deposits lie close to the surface and are marked by large outcrops of black flint and iron. An interesting account of the working of these mines was read before the Amer. Inst. of Mining Engineers by Mr. Ellis Clark, in which he gives the following theory of the ore-formation:

"It has been held, almost from the time of their discovery, by those familiar with the deposits of silver-ore at Lake Valley, that the one must have come up in solution from below, that it came along the 'blanket' of iron-flint, and that it was in some way dammed up or stopped by the overflow of porphyrite, which may be said, in a general way, to overlie the outcrop of the 'blanket.' On the strength of this

hypothesis, numerous diamond-drill-holes and shafts have been sunk, and those that were continued to a sufficient distance (seldom more than 150 feet) have encountered the iron-flint blanket, but invariably with its silver-contents lacking.

"A later and more probable hypothesis is that the silver of the mines was originally contained in a great overflow of silver-bearing porphyrite, perhaps coming from Monument Peak, which covered a square mile or more in the immediate vicinity of the mines. In the erosion of this porphyrite, the silver in it was leached out, the greater portion segregating itself in the Bridal Chamber and the workings connected with it, and the remainder going to the Bunkhouse and the connected Incline and Bella workings. The greatest distance that any large body of ore has been found from the line of the porphyrite is 500 feet, and most of the workings are within 200 feet of that line.

"The writer's own observations have shown him that a distance of about 250 feet from the porphyrite the ore decreases in grade, and that at a distance of 300 feet there is little that can be profitably shipped. The Bunkhouse workings appear to have been in a cavern, in which the ore was deposited rapidly, and not by the slower process of a dissolution of the limestone and a synchronous substitution of the silver-bearing manganese. In many places in this working the manganese is pulverulent and non-adherent to the limestone walls; and when thoroughly cleaned off by brushing, the face of the limestone has precisely the same weathered appearance as that of an outcrop, and looks as though it had been freely acted upon by the atmosphere, possibly assisted by the rays of the sun. Something of the same sort may be studied in the Last Chance workings at a depth of 20 feet from the surface, while the Bunkhouse workings lie at a depth of from 50 to 60 feet.

"The evidences of a previous cavern or cavity in the blue limestone at the Bridal Chamber are not so marked, but the indications are such that in the writer's opinion a comparatively rapid deposition appears more probable than a gradual substitution, such as was very likely the case in the Incline workings, the Bella Chute, the Thirty Slope and the Twenty-five Cut workings.

"In a property of the extent of the Lake Valley mines, which has yielded at least $5,000,000, there always remains the possibility of new finds through the expenditure of small amounts of money. The contact between the two limestones is an established fact; and there are but few places on the southeastern portion of the property where this contact cannot be reached at the moderate depth of 150 feet. Thus

far, the explorations made at a distance from the porphyrite have been barren of commercial results; but from the occurrence of the one in chutes, which, although constituting a part of the 'blanket,' vary in width (being generally narrow close to the surface and widening in depth), it is possible that large bodies, somewhat of the nature of the Incline or the Bella Chute, may exist still in the unexplored portions of the property.

"The occurrence of new bonanzas, such as the Bridal Chamber and the Bunkhouse, is scarcely to be expected, as the conditions under which they appear to have been found, that is, the triple contact of the Blue and Crinoidal limestones and the porphyrite, are not known to exist at any points as yet unexplored, and the overflow of porphyrite, has been so thoroughly prospected as to leave but little unexplored ground of that class.

The most promising quarter for further exploitation would seem to be the extension of the Grande chute cut at some point south of the John's shaft workings, where, as before mentioned, large chutes of iron-flint, too low in silver for profitable working, were cut. Other points which should be prospected are the extension of the Bella Chute beyond the point where it has been cut off by the Columbia fault." (Trans. Am. Inst. Mining Engineers).

Erosion of Submerged Limestones.—The limestones in the bottom of a certain portion of Lake Huron are undergoing a peculiar kind of erosion, which, from want of better terms to describe the process, which may be called honeycombing and pitting. Mr. Robert Bell has made a study of this phenomenon and after considering the physical characteristics of the eroded rocks, their age and the possible origins of the erosions, the author arrives at the following conclusions. The erosion is due to:

I. The internal structure of the limestone itself.

II. A small quantity of acid in the water acting for a great length of time.

III. A considerable depth of water, the hydrostatic pressure seeming to promote the dissolving of the rock.

IV. Freedom from sediment during the long time required.

V. The rock must be exposed to the open or free action of the water.

VI. Shifting currents in the water appear to assist the process. (Bull. Geol. Soc. Am., Vol. 6, 1895).

Irrigation of Western Kansas.—Prof. S. W. Williston believes that the cultivation of the western third of Kansas now known as a semi-arid region can be made possible by the utiligation of the so-called underflow of the uplands of that region. The gathering ground of this water, according to Williston, is an exposure of Tertiary sandstone which rests on an impervious marine deposit known as the Colorado Cretaceous. The dip of the chalks and limestones is towards the northeast where erosion in the valleys and along the eastern border has exposed the contact between the sandstone and limestone, springs are found, and pools of water, and even flowing streams, which, however, are soon absorbed through the adjacent soil.

The problem then is how to bring the water of this underflow to the surface economically. The limits of this water-bearing area should be determined and the amount of water that can be counted upon estimated. (Kansas University Quart., April, 1895).

Plistocene Deposits in Switzerland.—At a recent meeting of the Geological Society of London, Dr. C. S. Du Riche Preller read a paper on fluvio-glacial and inter-glacial deposits in Switzerland. The former consists of conglomerates 'and the latter are lignite deposits near the lakes of Turish, Constance, Zug and Thun; which together with analagous deposits at the base of the Eastern, Western, and Southern Alps, constitute further evidence of two interglacial periods, and therefore of three general glaciations, the oldest being of Upper Pliocene, and the others Middle and Upper Plistocene age respectively. As regards the origin, age and the time required for the formation of several of the Swiss deposits referred to in the paper, the author arrives in several respects at conclusions differing from those recently enunciated by others. The author also argues that the first interglacial period was probably of shorter duration than the second; and in confirming his former conclusion that every general glaciation marks a period of filling-up, and every interglacial period marks a period of erosion of valleys, he avers that, if this conclusion be correct, it must needs be destructive of the theory of glacial erosion. (Nature, April, 1895.)

Geological News. PALEOZOIC.—In a memoir recently published in the Trans. Roy. Soc., Dublin, Messrs. Lavis and Gregory confirm the conclusions reached by Mr. Mœbius that the phenomenon of Eozoon is due to mechanical and chemical alterations. In the rocks examined by the authors the Eozoon resuted from the alteration of

calcareous rocks enclosed in a magma heated to fusion—a true metamorphism. (Revue Scientifique Fevier, 1895).

Mr. Walcott notes the occurrence of Olenellus in the limestone of the Green Pond mountain series of northern New Jersey. He considers the discovery a positive addition to the data for working out the stratigraphy of the series. Occurring as it does, in a limestone that merges above and below into beds of conglomerate that are essentially of the Green Pond mountain type, it proves that the conditions under which this characteristic formation was formed, began in lower Cambrian time. (Am. Journ. Sc., 1894).

MESOZOIC.—It is well known that Triassic rocks have yielded large quantities of good coal in Virginia and North Carolina, but it is only within the last year that coal in paying quantities has been found in Pennsylvania Trias. Early in 1894 a vein of anthracite coal of fine quality, twenty-six inches thick, was discovered at Arcola Station, on the Perkiomen railroad, about twenty-five miles from Philadelphia. The rock in which it occurs is red sandstone of Triassic age.

Other instances of the occurrence of coal in Montgomery Co. reported by Mr. Oscar Franklin as follows: In the new red sandstone at Norristown; at Gwynedd in the same formation, and at Lower Providence, Lansdale and Hatboro. A systematic search of the slates underlying the sandstone in Montgomery Co. would, perhaps, disclose beds of workable coal in more than one locality. (Journ. Franklin Inst., 1894).

In Colorado College Studies for 1894, Mr. F. W. Cragin notes 2 new reptiles and 3 new fishes from the Neocomian of Kansas. They are described under the following names: *Plesiosaurus mudgei* represented by a femur, humerus and dorsal vertebræ. *Plesiochelys belviderensis* represented by several costal bones, neural bone and a vertebra. *Mesodon abrasus* represented by vomerine teeth. *Lamna quinquelateralis* and *Hybodus clarkensis* based respectively on a vertebra and on a fin spine. Figures accompany the descriptions.

CENOZOIC.—After reviewing the evidence for changes of elevation of the Atlantic coast of North America, Mr. N. S. Shaler states that since the beginning of the Glacial epoch the eastern shore of North America from the Rio Grande to Greenland has, though with many minor oscillations, been prevailingly lowered. The fauna of the Caribbean District points to a recent subsidence of that region, including the peninsula of Florida. The flooding of the Amazon and La Plata

Rivers, together with a number of lesser streams affords similar evidence for the eastern coast of South America. Africa and Australia appear to have been but little, if any, subjected to recent depressions, while Asia and especially Europe afford clear evidence of extensive subsidence in recent times. On the whole, it would seem that in the disturbances of the relations of land and sea, the tendency is a gradual withdrawal of the coast line towards the center of the continents. (Bull. Geol. Soc. Am., Vol. 6, 1895).

Further evidence in favor of the theory of the igneous origin of the serpentine of the Coast Ranges is found by Prof. Laplache in the study of the Lherzolite-Serpentine rocks of the Potrero, San Francisco. The petrographical character of these rocks show undoubtedly their derivation from an eruptive rock in this area. (Bull. Dept. Geol. Cal. University, 1894).

BOTANY.[1]

A Protest Against the "Rochester Rules."—Quite recently, a protest, signed by seventy-four American botanists, has been distributed, as a contribution to the literature of the nomenclature question. It protests "against the recent attempts made in the United States to change botanical nomenclature on theoretical grounds." This rather vague statement evidently refers to the action of the botanists of the Botanical Club of the American Association for the Advancement of Science taken in Rochester in 1892, and reaffirmed in Madison in 1893. Why the grounds of the action taken at Rochester are considered by the protestants to be theoretical is not made plain; certainly the protestants do not wish to affirm that the men who are prominent in the reform of nomenclature are theorists, nor can they mean that a discussion of nomenclature reform by working botanists is itself theoretical, since a suggestion is made approvingly of an early consideration of the whole subject by a representative international congress.

There is much in the protest with which most botanists will agree, but much of what is said does not apply to the Rochester Rules. Thus the proposition that "one of the most essential features of an efficient

[1] Edited by Prof. C. E. Bessey, University of Nebraska, Lincoln, Nebraska.

botanical nomenclature is a cosmopolitan character," is not to be questioned, and the Rochester movement was intended to be a step toward such a result. So also the first rule proposed by the protestants, viz.: that "ordinal names having long-established usage should not be subjected to revision upon theoretical grounds," is one with which few will disagree, and this again was not referred to in the Rochester Rules. The rule requiring the retention of "long-established and generally known generic names" is a curious one. Starting out with the positive statement that they should be retained, we are next told that "the scope of this rule is left to the discretion of writers"!! How about those whose discretion results in a more rigid scrutiny of such doubtful names? Under the rule, who shall judge between us when we disagree? Moreover, it is urged upon writers that generic nomenclature should not depart far from Benthams and Hooker's Genera Plantarum, Baillon's Histoire des Plantes, and Engler and Prantl's Natürlichen Pflanzenfamilien—"*for the present*"! No plank relating to a doubtful question in politics could be more ambiguously drawn so as to provide that flexibility necessary to meet individual preferences. After permitting individual discretion, and allowing some departure (less than the vague distance, "a") from three somewhat different standards, and this only for the present, how much efficiency is left in the rule?

The third rule is scarcely less curious than the second. It is that "in specific nomenclature the first correct combination is to be preferred." Of course. Nobody is asked by the Rochester Rules to prefer any other than the first correct combination. The form of the rule is absurd. The protestants certainly do not wish us to infer that there may be a second "correct combination"—or possibly more. That would be a peculiar priority rule, indeed! But this is not what the protestants wished to say. They probably meant to say that "the correct specific name of a plant is that which it first bears after it has been referred to the proper genus," at least this is what the context suggests. The argument for this rule of priority under the genus, as against the third of the Rochester Rules, can not be said to be well sustained. Many of the earlier references of species to genera from which they had subsequently to be removed, can not, in justice, be regarded as cases of "description under an incorrect genus." Are we simply to ignore the fact as of little importance that Linné described a plant now known as *Steironema ciliatum* ninety years earlier than the date of its transfer from *Lysimachia* to *Steironema?* It is very difficult to see wherein the binomial has any advantage over the specific

name in point of stability, or in certainty as to its origin. The instability of specific names is greatly exaggerated by the protestants, and it was to cure the evil so much dreaded by them that Rule III of the Rochester Rules was formulated. At the end of the discussion, however, the whole case is surrendered by the protestants in requiring botanists in the present and future "to preserve scrupulously the specific name without alteration in transferring species from one genus to another."

The fourth rule proposed, which insists upon a sharp line of demarkation between specific and varietal names is not unreasonable to those who hold that species differ radically from varieties. There are still some people who believe in the fixity and original independence of species, and hence of varieties, also, and for whom the facts of development and evolution have no significance. For such, the rule is a logical necessity. The final pronouncement (5) that the principle "once a synonym always a synonym" is recommended as "an excellent working rule for present and future use," is stultified by the addendum to the effect that it "may not be made retroactive." The framers of these rules appear to have a horror of anything which is retroactive, as if for a rule or law to be retroactive were very bad or very dangerous. The word is held up as a sort of bug-a-boo to frighten us. What do they mean by recommending the present use of the rule "once a synonym always a synonym," but forbidding its retroactive use. What is there so sacred in the work of the years preceding the appearance of this protest that it should be spared the application of a principle which the protestants declare to be "an excellent working rule?"

It is necessary to notice but one more of the many curious things in this remarkable document, viz.: the statement that "these rules are designed to apply only to phænogams [sic] and vascular cryptogams." What will the algologists do, and the fungologists, and bryologists? Are they to be allowed to wander around in darkness and disorder, when, by a stroke of the pen, their outlying provinces of the botanical kingdom might have had the benefits claimed by the protestants for their rules. If these rules are good, there is no reason for restricting their application so as to exclude any department of descriptive botany.

CHARLES E. BESSEY.

The Missouri Botanical Garden.—The attention of botanists is called to the facilities afforded for research at the Missouri Botanical Garden at St. Louis. In establishing and endowing the Garden, its founder, Henry Shaw, desired not only to afford the general public

pleasure, and information concerning decorative plants and their best use, and to provide for beginners the means of obtaining good training in botany and horticulture, but also to provide facilities for advanced research in botany and cognate sciences. For this purpose, additions are being made constantly to the number of species cultivated in the grounds and plant houses, and to the library and herbarium, and, as rapidly as it can be utilized, it is proposed to secure apparatus for work in vegetable physiology, etc., the policy being to secure a good general equipment in all lines of pure and applied botany, and to make this equipment as complete as possible for any special subject on which original work is undertaken by competent students.

A very large number of species, both native and exotic, and of horticulturists' varieties, are cultivated in the Garden and Arboretum and the adjoining park, and the native flora, easily accessible from St. Louis, is large and varied. The herbarium, which includes nearly 250,000 specimens, is fairly representative of the vegetable life of Europe and the United States, and also contains a great many specimens from less accessible regions. It is especially rich in material illustrative of Cuscuta, Quercus, Coniferae, Vitis, Juncus, Agave, Yucca, Sagittaria, Epilobium, Rumex, Rhamnaceae, and other groups monographed by the late Dr. Engelmann or by attachés of the Garden. The herbarium is supplemented by a large collection of woods, including veneer transparencies and slides for the microscope. The library, containing about 8,000 volumes and 10,000 pamphlets, includes most of the standard periodicals and proceedings of learned bodies, a good collection of morphological and physiological works, nearly 500 carefully selected botanical volumes published before the period of Linnaeus, an unusually large number of monographs of groups of cryptogams and flowering plants, and the entire manuscript notes and sketches representing the painstaking work of Engelmann.

The great variety of living plants represented in the Garden, and the large herbarium, including the collections of Bernhardi and Engelmann, render the Garden facilities exceptionally good for research in systematic botany, in which direction the library also is especially strong. The living collections and library likewise afford unusual opportunity for morphological, anatomical and physiological studies, while the plant house facilities for experimental work are steadily increasing. The E. Lewis Sturtevant Prelinnean library, in connection with the opportunity afforded for the cultivation of vegetables and other useful plants, is favorable also for the study of cultivated plants and the modifications they have undergone.

These facilities are freely placed at the disposal of professors of botany and other persons competent to carry on research work of value in botany or horticulture, subject only to such simple restrictions as are necessary to protect the property of the Garden from injury or loss. Persons who wish to make use of them are invited to correspond with the undersigned, outlining, with as much detail as possible, the work they desire to do at the Garden, and giving timely notice so that provision may be made for the study of special subjects. Those who have not published the results of original work are requested to state their preparation for the investigation they propose to undertake

Under the rules of Washington University, persons entitled to candidacy in that institution for the Master's or Doctor's degree, may elect botanical research work as a principal study for such degrees, if they can devote the requiste time to resident study.

WILLIAM TRELEASE, *Director.*

A New Astragalus.—On June 25, 1892, I started out for a collecting trip from the village of Long Pine, Brown Co., Nebraska. On the outskirts of the village, I came across a patch of *Astragalus lotiflorus*, and mingled with it were plants of similar form and habit, but separated by their extreme hirsuteness. I collected a few of each, knowing that the latter form was new to me, at least; but, not having in my possession all the *Astragali*, even of Nebraska, did not know that it would be new to others. On my next visit, a month later, I found that a flock of sheep had grazed everything to the ground, eating, probably, fruit and all. Many subsequent visits have resulted in determining that the form is very scarce. A few scattered plants have been found along a roadside 100 rods north; none elsewhere, except that a few days' later in the same year, Mr. J. A. Warren found *one plant* in Clay County in southeastern Nebraska. This spring I have been able to find but two plants, the species *lotiflorus* itself being very scarce in the same localities. The new plant is undoubtedly a variety of *A. lotiflorus* Hook., and is described as follows:

Astragalus lotiflorus Hook., var. *nebraskensis*., n. var. Biennial, or shortlived perennial; the long, very slender tap-root sparsely or not at all fibrous for several inches above; stems 2 to 5 inches long, prostrate-spreading and scarcely ascending, in the larger forms, nearly erect in the smaller, numerous from a crown at or above the surface, stouter than the root; simple; hirsute throughout with white hairs, the half-grown fruit being scarcely visible; leaves 3 inches in length, on furrowed petioles, one inch long; leaflets 7–13, short-petioled, oblong to

oblanceolate, very variable, slightly acute to obtuse, less hirsute on the upper surface; stipules ovate, acuminate, scarious-margined, inclined to be scarious with green veins; flowers like *lotiflorus*, very small, yellowish-white to pale lilac, one to three in a raceme almost sessile in the axils of leaves, peduncle lengthening to half an inch in fruit; *not* like *lotiflorus* in equalling the leaves; calyx with lanceolate, acuminate teeth, persistent; legume right-angled from the peduncle, half-ovate or slightly crescent-shaped, acuminate 1 inch long, 4 lines deep, sessile in the calyx, thick chartaceous, one-celled, sometimes cross-wrinkled; seeds in two rows, short-kidney-shaped, numerous.

Specimens have been deposited in the herbaria of the Botanical Survey of Nebraska, University of Minnesota, and Columbia College.

—J. M. BATES.

Long Pine, Neb., May 20, 1895.

VEGETABLE PHYSIOLOGY.[1]

The Action of light on Bacteria.—Under the above title Dr. H. Marshall Ward contributes an interesting article to the *Philosophical Transactions* of the Royal Society of London, Vol. 185 (1894), pp. 961–986. While his experiments have not been confined to the anthrax bacillus, most of those here detailed were made with this organism. The spores were sown in melted agar which was then poured into Petri dishes in the usual way. Portions of these agar films were then exposed to direct sunlight and to the arc light. On the shaded parts of the agar the colonies derived from these spores grew until they completely covered it, while they wholly failed to develop at first, but finally did so in small numbers on the parts exposed to direct sunlight for several hours. After exposure the cultures were placed in an incubator at 20–22° C., only being taken out to examine and photograph. By 3–4 hours exposure to direct bright sunlight and subsequent incubation for a few days, figures and stenciled letters were brought out very distinctly on the surface of the inoculated plates. That this effect is due to insolation has been shown by various writers and is now generally accepted, and that the effect is due to the direct

[1]This department is edited by Erwin F. Smith, Department of Agriculture, Washington, D. C.

action of the light on the organisms and not to any indirect action on the culture medium, has been brought out pretty clearly by Prof. Ward's labors. That the agar remains unchanged and is still suited to the needs of the organism is shown by the fact that some colonies do always finally appear on the insolated spots. Their appearance is explained by supposing that some spores were covered by others and thus partially protected from the action of the light, which might well be the case, especially when thick sowings were made. The next step was to determine, if possible, whether one part of the spectrum was more effective than another, the conclusions of previous experimenters being very contradictory. First, a fresh culture was covered by a card board in which five circular holes were cut. One of these holes was left uncovered, one was covered by ordinary window glass, one by a dark blue glass, one by a light blue glass, and finally, one by a peculiar brownish-purple glass which absorbed most of the blue and violet rays of the spectrum. This plate was then exposed to sunlight for some hours and afterwards put into the incubator. In 18 hours there were four distinct white spots on the agar corresponding to four of the five holes in the card board, and later on that spot corresponding to the uncovered hole became the most distinct. There was also on the agar at first a fainter spot corresponding to the hole covered by the brownish-purple glass, but this spot became more and more indistinct and disappeared after the fourth day, enough colonies having developed finally to wholly efface it, thus showing that the light strained through this glass simply retarded the development of the spores. The inference was, therefore, quite strong, that the blue-violet rays largely screened out by this glass must be the effective ones. Two-chambered, ebonite cells with side walls of glass were then constructed. Into one of the cells filtered distilled water was put as a standard for comparison and into the other cell was put solutions of various substances such as aesculin, sulphate of copper, bichromate of potash, quinine, fuchsin, etc., which cut out certain rays of the spectrum. Infected films of agar were then exposed to the action of sunlight passed through water and these solutions. The light which passed through the layer of water cleared a spot on the plate every time. The result of passing the light through a solution of aesculin, which cuts out most of the blue and violet rays, was similar to that obtained by the use of the brownish-purple glass, i. e. it did not kill the spores but only retarded their germination, the insolated places being nearly obliterated in 111 hours and entirely so a little later. When sunlight was passed through a solution of potassium bichromate the result was still more striking, not

a trace of any germicidal influence being visible. From the foregoing it is apparent that the red, orange, yellow, and true green rays of the spectrum have no bactericidal action. Finally, portions of infected plates were submitted to the direct action of portions of the solar spectrum, passed through a grating as narrow as practicable (1 mm.) and through quartz plates instead of glass. These exposures confirmed the preceding and show that the infra-red, red, orange, and yellow rays of the spectrum are absolutely without effect, the spores exposed to these rays germinating as readily as those on the non-exposed parts of the film. So far as could be determined by the methods used, the bactericidal influence begins where the green shades into the blue, reaches its greatest intensity in the blue-violet in the vicinity of Fraunhofer's line G, and fades out in about the middle of the violet, the more refrangible half of the violet and the ultra violet showing no influence. Subsequently, in conjunction with Prof. Oliver Lodge of Liverpool, many experiments were tried with a powerful arc light. Even 8–12 hour exposures produced only a transient bactericidal effect when its rays had to traverse the glass covers of the Petri dishes, and in course of the experiments it was discovered that even the thinnest plate of glass is so obstinate a barrier to the bactericidal rays that it was not possible to use it and quartz had to be substituted. When this was done, 8–12 hour exposures served to kill the spores of Bacillus anthracis, and even 6 hours exposure killed great numbers of them. Exposures of infected films to the spectrum of the arc light gave results in the main confirmatory of those previously obtained. Here again the infra-red, red, orange, yellow, and green rays were without perceptible effect, but the germicidal influence did not begin in the blue-green but just beyond it in the blue, and its influence was visible into the ultra violet, the maximum effect being reached just beyond the violet. With both sun and arc light there is for a day or two after the colonies begin to appear a curious blurring of the margins of the insolated spots which gradually disappears as the colonies develop and which is attributed to halation. The germicidal effect of the arc light is so powerful, when not destroyed by glass screens, that Prof. Ward thinks it might be turned to practical account in the disinfection of hospitals, cattle sheds and similar places. In these experiments the distance of the light was two feet. The author is inclined to think that not only the lower forms of life but also all protoplasm is sensitive to these rays of the spectrum and that the higher plants escape injurious effects by having provided themselves with natural color screens. Among other low organisms which he has found sensitive to direct sunlight are a violet

water bacillus from the Thames, B. fluorescens liquefaciens, a pink bacterium (probably B. prodigiosus), the hay bacillus, the potato bacillus, and various yeasts and other fungi.

The role of Calcium and Magnesium.—Bokorny seems to have proved (*Bot. Centrb.*, 62:1) that Ca and Mg are essential to the formation of the necleus and chlorophyll bodies. His experiments were with Spirogyra, Zygnema, and Mesocarpus in Aluminum beakers in distilled water to which nutrient salts were added: (1) Ca withheld; (2) Mg withheld; (3) Ca and Mg withheld; (4) Complete. The algæ were under observation 6 weeks. In 1 there was a gradual decided shrinkage of the chlorophyll bands although starch continued to form. In 2 the nucleus and pyrenoids also shrank, the former to ¼ natural size or to complete disappearance. In 3 the nucleus shrank decidedly and the pyrenoids seemed to become smaller. In 4 the cell-organs remained normal and the plants continued bright green.—Erwin F. Smith.

ZOOLOGY.

The Faunal Regions of Australia.—At the Adelaide meeting of the Australian Association for the Advancement of Science, Mr. Hedley gave a brief summary of the views held by leading naturalists in regard to the Faunal Regions of Australia, and also presented his own. The substance of his remarks were as follows:

The discrimination of the various provinces into which the Australian fauna and flora group themselves has been frequently attempted. To the earlier naturalists, from a study of scanty material and with little or no personal knowledge of the continent, four divisions of east and west, temperate and tropical, seemed natural and sufficient. Horker's "Essay on the Australian Flora" paved the way for a better understanding of the relations which various localities bore to each other. Owing to fundamental errors of his interpretation of Australian Geology, Wallace's treatment of the subject in "Island Life" is of but slight value. To the writer, the most successful arrangement of the various biological regions yet proposed is that sketched by Prof. Tate, in his address to the first meeting of this Association. The author accepts two main biological divisions—the *Autochthonian*, developed in west

Australia, and the *Euronotian*, seated in eastern Australia and Tasmania; a subsidary division, less in value and derivable from both of the above, is the *Eremian* or desert fauna and flora.

Taking this disposition as the basis of my remarks, I would observe that eastern Australia contains two distinct biological populations, where Professor Tate has located one, the *Euronotian*. This title, I propose, should be reserved for that fauna and flora characteristic of Tasmania, Victoria, and southern New South Wales; while the second and very distinct fauna and flora developed on the coasts of Queensland and northern New South Wales would best be described as Papuan. Indeed, so distinct is this latter, that a separation of Australian life into Papuan and non-Papuan seems to the writer to be the primary division to be made of the Australian fauna and flora.

The types encountered by a traveler in tropical Queensland, or rather in that narrow belt of tropical Queensland, hemmed in between the Cordillera and the Pacific, all wear a foreign aspect. Among mammals may be instanced the cuscus and tree kangaroo; among reptiles, the crocodile, the *Rana*, or true frog, and the tree snakes; among birds, the cassowary and rifle birds; among butterflies, the Ornithoptera; among plants, the wild banana, orange and mangosteen, the rhododendron, the epiphytic orchids, and the palms; so that, in the heart of a great Queensland "scrub," a naturalist could scarcely answer, from his surroundings, whether he were in New Guinea or Australia. It may be supposed that late in the Tertiary epoch, Torres Straits, now only a few fathoms deep, was dry land, and that a stream of Papuan life poured into Australia across the bridge so made.

Sharply defined from the tropical jungle above mentioned are areas occupied by strictly Australian vegetation, which are left invariably in possession of the poorest tracts of land. From the rich lands, formerly no doubt possessed by them, everywhere have they been ousted by the invading flora.

Regarding the origin of the Eurontian fauna and flora, sundry facts collected by Mr. H. O. Forbes, in his paper on the Chatham Islands, would suggest a South American source. Assuming that, in or before the Miocene, continuous land extended from Terra del Fuego to Tasmania, the derivation of the Australian marsupials appearing in the Pliocene from their South American allies, *Prothylacinus* and *Amphiproviverra* of the Eocene, would be clear. Mr. Forbes adduces strong confirmatory evidence from Professor Parker who, on embryological grounds, does not hesitate to assume as ancestors of certain Australian crows a form allied to the American Dendrocalaptine birds. The dis-

tribution of the parrots and the cystignathous frogs appears also to sustain the theory. The extinct alligator, *Palimnarchus*, found in Queensland and New South Wales associated with *Diprotodon*, strengthens the chain of evidence, as does the occurrence in Tasmania and Australia of *Gundlachia*, otherwise an exclusively American mollusc.

As the name implies, the *Autochthonian* is the oldest member of the Australian faunas and floras. The date of its arrival in Australia and the route which it traversed are lost in antiquity. Seeing that many resemblances exist between our vegetation and those of Timor and the southeast Austro-Malayan islands, perhaps these lands afforded the passage to Australia.

Summary.—Superimposed, one above another, may be distinguished three divisions of Australian life. The earliest is the Autochthonian. Possibly this arrived from the Austro-Malayan islands, in or before the Cretaceous era, and spread over the whole of Australia. The next is the Euronotian. Probably this reached Tasmania from South America, not later than the Miocene epoch; many of the original inhabitants, particularly on the east coast, probably disappeared before the invaders. Thirdly, a contingent of Papuan forms seized on the Queensland coast, late in the Tertiary, and likewise largely exterminated their predecessors.

Notes on a Snapping Turtle's Nest.—On June 16, 1894, I saw a snapping turtle, *Chelydra serpentina*, in the course of two hours, dig a hole and in it lay twenty-two eggs.

The hole was dug in gravel and was small at the top, but when an inch below the surface of the ground, it widened, and when finished was three inches in diameter and about four inches deep. The digging was done entirely by the hind feet used alternately.

The eggs were crowded in place by the hind feet, as fast as they were laid. Then the hole was filled even with the rest of the ground. The nearest water was a small stream about thirty feet distant.—A.

On some new North American Snakes, NATRIX COMPRESSICAUDA TÆNIATA subsp. nov.—Scales in twenty-one rows; four series of longitudinal spots above, those of the median pair forming two longitudinal stripes on the greater part of the length; the laterals forming stripes on the neck only.

Labials $\frac{8}{10}$, oculars 1–3; temporals 1–3. Frontal narrow, not widened anteriorly; parietals rather wide. First row of scales keeled.

Gastrosteges 131; anal 1-1; urosteges 82. The lateral black spots extend as far as the tail. The dorsal stripes are connected by a transverse lighter brown shade for a short distance in advance of the vent. Belly black with a median series of semidiscoid yellow spots; gastrosteges with yellow extremities for the anterior two-thirds of the length of the body. The median neck stripes touch on the nape, and after enclosing a pale space unite on the parietal plates. Muzzle brown, the labials with blackish shades. Lower labials, genials and gulars with yellow spots. Indistinct parietal paired spots. Total length 378 mm.; of tail 98 mm.

Two specimens in my private collection from Volusia, Florida.

In this form the striping which appears on the neck of the form *compressicauda* is extended the entire length. It bears thus a partial resemblance to the *Natrix clarkii*, which is not far removed in affinity from the *N. compressicauda*. The form next described (*N. fasciata pictiventris*) connects the latter with the *N. fasciata*.

The subspecies *tæniata* may be synoptically compared with the typical *compressicauda* as follows:

Scales in 21 rows; four series of longitudinal spots above, those of the median pair forming two longitudinal stripes on the greater part of the length; the laterals forming stripes on the neck only;

N. c. tæniata.

Scales in 21 rows; numerous dark cross-bands which are resolved into three rows of spots just anterior to the tail, and four longitudinal stripes on the neck; *N. c. compressicauda.*

NATRIX FASCIATA PICTIVENTRIS Cope.—Brown transverse bands numerous, separated by short intervals and extending to the belly throughout the length. Gastrosteges narrowly margined at the base with brown, the margins turning at or before reaching the ends of the gastrosteges and uniting so as to enclose transverse yellowish spots, which may cover a part only or the whole of the gastrostege, but which are always wider than those seen in *N. compressicauda*. Sides of head light brown, generally with a black post-ocular band; top of head black. Scales in 25 rows; in one specimen (No. 19,798) in 27 rows.

No. 5,473 : 25; 8 : 125; 45 : 580 mm.; 120 mm.; (tail injured).

No. 19,999 : 25; 8 : 124; 86 : 550 mm.; 162 mm.

In some specimens (No. 13,729) the transverse bands are very distinct as in young individuals; in Nos. 19,798 and 11,444, they are connected by the same color along the median dorsal line.

This subspecies is restricted to Florida, and it approaches the *N. compressicauda* in the coloration of the belly. The following specimens are contained in the U. S. National Museum.

5,473 1, Palatka, Fla., T. Glover. Type, 10,449 2, Gainesville, Fla., J. Bell; 10,739 1, Clearwater, Fla., S. T. Walker; 11,444 1, Gainesville, Fla., J. Bell; $\frac{13644}{13693}$ 2, Georgiana, Fla., G. Wittfield; 13,779 1, Punta Rassa, Fla., C. K. Ward; 19,798 1, W. Florida, Dr. Henshall; 19,999 1, Lake Eustis, Fla., Theo. Holm.

In my private collections are specimens from Volusia, Lake George, Fla. A specimen now living in the reptile house of the Zoological Garden of Philadelphia exhibits the following colors. The borders of the transverse bars, and the markings on the belly are chestnut red, while the ground-color of the latter is cream colored.

SEMINATRIX PYGÆUS Cope, gen. nov.— *Contia pygæa* Cope, *Tropidonotus pygæus* Boulenger. This species has been referred to the water snakes of the genus Tropidonotous (Natrix) by Boulenger (Catal. Snakes Brit. Mus. Ed. II, V. 1). An examination of the penial structure shows that the reference to the Natricinæ is correct. The other characters differ, however, from those of the genus Natrix, so that it appears to be necessary to refer it to a new genus. This I propose to call Seminatrix, and give the following definition. Sulcus spermaticus and hemipenis undivided; no papilla; scales smooth, without keel or pits; anal plate divided.

The only known species *S. pygæa* is found in Florida. According to Dr. Loennberg.[1] its habits are aquatic. While the epidermal scales are smooth, the dermal plates are closely wrinkled and reticulated, a character which I have not observed in any other Natricine and which may be an additional generic character.

ZAMENIS STEJNEGERIANUS sp. nov.—This species and the one following belong to a section of the genus not represented in my "Critical Review" (p. 622), which must be characterized as follows: Superior labials eight; scales in seventeen rows; frontal as wide posteriorly as the superciliary at the same point. To this this might be added, loreal much longer than deep.

In the present species the profile is gently convex, and the rostral plate is slightly prominent. The frontal plate has straight lateral borders and its anterior angles are well removed from the preocular plates. The loreal is twice as long as deep, and its superior posterior corner is cut off as a separate plate on both sides, and on one, a third loreal is cut off below. The eight superior labials are regular, and apparently normal. The parietals are truncate posteriorly, and are bounded by three temporals and two small scales externally. Temporals 2–2–2. Postgenials shorter than pregenials. Gastrosteges 166; anal 1–1; urosteges 102. Length 782 mm.; of tail, 229 mm.

[1] Proceeds. U. S. Natural Museum, 1894 p. 323.

Above and ends of gastrosteges, light brownish-olive; top of head, lips, and inferior surfaces yellow. Skin between scales, black. No. 17,065 U. S. National Museum, Cameron Co., Tex. Dedicated to my friend Dr. L. Stejneger of the U. S. National Museum.

ZAMENIS CONIROSTRIS sp. nov.—The second species of the section of the American species of the genus presents the following characters.

Profile of muzzle much decurved; rostral plate prominent and subconic. Frontal plate with concave lateral borders, and expanded front, in contact with preoculars. A single loreal which is nearly twice as long as deep, and is deeper posteriorly than anteriorly. Parietal plates rounded posteriorly, bordered by three temporals and two or three scales. Temporals 2–2–2. Superior labials normal, regular. Postgenials equal in length to pregenials. Gastrosteges 162; anal 1–1; urosteges 85. Length 758 mm. length of tail 200 mm.

The specimen may have been taken near the period of moult, so that the color is somewhat uncertain. It is now light brown above, and light plumbeous below; the top of the head not lighter than the other superior surfaces. The muzzle is darker in color than the lips and throat. Skin between scales black. No. 1,763 U. S. National Museum, Matamoras, Mex.

This species and the last are founded on a single specimen each, which were obtained in nearly the same region of country. They resemble each other considerably in proportions, size and coloration. The differences are, however, so numerous and important that it is impossible to regard them as belonging to the same species. They differ equally from all others, the nearest approach to the *Z. stejnegerianus* being made by abnormal individuals of the flaviventris form of *Z. constrictor*, which have eight superior labial shields. The very different form of the loreal plate, and its subdivison, in the latter, together with the contrast between the color of the head and the dorsum, will distinguish it.

ZAMENIS LATERALIS FULIGINOSUS Cope.—*Bascanium laterale* Hallow. Cope, Proceeds. U. S. Natl. Mus., 1889, f. 147.

Scales in seventeen longitudinal rows; superior labials eight, the fourth and fifth entering the orbit. Muzzle depressed, narrowed and rather prominent. Frontal plate much narrowed posteriorly, its width equal one-half that of a superciliary plate. Seventh and eighth superior labials about equal, of rather wide parallelogrammic form. Temporals 2–2–2; the last superior large, subquadrate, their posterior borders continuous with that of the parietals. Gastrosteges strongly angulated; tail entering 3·58 times in whole length. Scuta, scutella and dimensions:

No. 15,135; 201; 1–1; ? ; 815 mm.; tail injured.

No. 15,136; 205; 1–1; 108; 665 mm.; 258 mm.

Color above blackish-brown anteriorly, becoming lighter posteriorly to the end of the tail. The dark color extends on each end of the gastrosteges to the angulation throughout the length, and in the younger specimen, appears as a row of spots on each side of the middle part of the gastrosteges, fading out beyond the middle of the length. Ground color of belly yellow. In the larger specimen the black-brown predominates on the inferior surfaces, yielding gradually to the ground color, which predominates on the inferior surface of the tail. A yellow spot on the preocular; and in the younger specimen on the postoculars and labial plates. Gular and genial plates yellow spotted in the younger specimen, nearly uniform dark brown in the older. On the anterior part of the body of the younger specimen the lateral scales to the third and fourth row have brown shades, with an obscure trace of cross-banding. On the same specimen near the middle of the body, there are two pale half-cross-bands near together. In the same, the center of each parietal plate is brown.

This subspecies differs widely from the typical form in color characters.

I add here that specimen which strongly resembles this form was sent to the Philadelphia Zoological Garden from Southern Arizona. The belly is light red.

Catal. no.	No. specimens	Locality	Whence obtained
15,135 15,136	1 1	St. Margarita Island, Lower California	U. S. Fish Commission Albatross

—E. D. Cope.

Zoological News, Vermes.—*Distomes.* Dr. H. B. Ward has recently published several papers on these parasites to which attention should be called, since they appear in places where one does not usually look for zoological articles. In the first[1] he records a second American example of the fluke, *Distomum westermannii*, this time from the lungs of a dog, the material being furnished by Prof. D. S. Kellicott, and being that upon which the latter author had already reported.[2] The second of these papers[3] reviews the literature of this

[1] Veterinary Magazine, Vol. II, p. 87, 1895.

[2] Trans. Ohio State Medical Society, 1894.

[3] Medical News, Mar. 2, 1895.

same parasite and emphasizes the dangerous nature of it when present in man. In the East (Japan, Formosa, etc.) it occurs in a large percentage of the population. A third paper[4] records the presence of *Distomum felinum* in the cats sacrificed to science in the University of Nebraska. In this paper, Dr. Ward discusses the value of measurements and concludes that they are of little value; "the topographical relations alone are fixed and hence are the only points on which species may be founded."

PROTOCHORDATA.—A species of Enteropneustan has been discovered upon the shores of New South Wales. It is described by its finder, J. P. Hill, under the name *Ptychodera australiensis* (Proc. Linn. Soc. N. S. Wales, Nov. 28, 1894).

ENTOMOLOGY.[1]

Distribution of Injurious Insects.—In an interesting paper upon this subject before the Entomological Society of Washington, Mr. L. O. Howard said: "It is reasonable to suppose that in many cases insects will be unable to follow their food-plants to the limits of their possible range, notwithstanding the fact that the geographical distribution of animals and plants is governed by the same general laws of temperature, humidity, exposure, and geological characteristics. The obvious reason for this is, that purely artificial features are introduced in cultivating plants, varieties are propagated which develop resistant powers lacking in the parent stock; seeds, in the case of annuals, are carefully collected and selected, the soil is prepared for their reception, and is artificially fertilized; while with perennials the same general care is taken. It follows, therefore, that the natural range of cultivated species is widely extended in every direction, and in the teeth of the very barriers which naturally would have held them rigidly in check. Plant-feeding insects in general follow the natural distribution of their specific food. Experience has shown that as this natural food becomes a cultivated crop they increase. As the cultivation of the crop is spread along natural lines of distribution, they follow it. When, however, by

[4] Veterinary Magazine, 1895.

[1] Edited by Clarence M. Weed, New Hampshire College, Durham, N. H.

artificial selection, hardy varieties of the crop plant have developed, and the range becomes thus extended along what may be termed unnatural lines, with certain species, at least, and within certain limits with them, their insect enemies will naturally be unable to follow them. The result will be, theoretically, natural selection with the insects trying to catch up with the results of artificial selection with the plants."

An All-purpose Net.—There is no doubt but that a special net for each kind of collecting will give the best results, but while the net becomes better suited to one purpose it becomes at the same time less suited to other purposes. A specialist will adopt a special net, but an ordinary collector will want an all-purpose net even if not quite the best for each insect.

The net we have found to meet best the requirements of an all-purpose net is one consisting of a strong but light brass hoop about a foot in diameter, soldered firmly into the end of a brass or tin ferrule. This ferrule should be about six inches long to serve as a handle when beating, when long handle is removed.

The bag of the net should be of strong but light cloth as a good muslin or swiss. It should be about two feet deep, and taper gradually from the mouth to the bottom where it should be two or three inches wide. This will enable one to easily remove an insect with the cyanide bottle or with the hand, and facilitates the clearing of the net by reversing it.—*Entomologists Post-Card.*

Picobia villosa (Hancock) is *Syringophilus bipectinatus* (Heller).—In the number of April, 1895 of THE AMERICAN NATURALIST (Vol. XXIX, p. 382–384, plate XXII), Mr. Joseph L. Hancock describes and figures as "*a new Trombidian*" a species of *Cheyletinæ* already well known in Europe. His *Picobia villosa* does not differ from *Syringophilus bipectinatus* Heller.

Mr. J. L. Hancock is not acquainted with the modern literature on interesting type. In a communication made, in 1884, before the *Académie des Sciences de Paris*[2], I have shown how this form is common on the birds of all orders. It lives in the quill of the feathers of the wings, and comes out but rarely.

The *Syringophilus bipectinatus* and its variety *major* have been figured by Professor Antonio Berlese, from my preparations, in his great work entitled: *Acari, Myriopoda et Scorpiones Italiani* (fasc. XXXVII, n° g et 10, 2 pl.).

[2] TROUESSART *Sur les Acariens qui vivent dans le tuyau des plumes des Oiseaux*, —(Comptes-Rendus Acad. des Sciences de Paris, XCIX, (1884), p. 1130).

This Acarid has been found in the interior of the quills of the wings (*rémiges et couvertures alaires*) on the domestic hen (*Gallus domesticus*), on the sparrow (*Passer domesticus*), and on a great number of other birds belonging to the genera:—*Syrnium, Eclectus, Pœocephalus, Chalcopsitta, Picus, Fringilla,* (var. *major* on *F. montifringilla*), *Emberiza, Linota, Coccothraustes, Troglodytes, Anthornis, Parus, Orites, Turdus, Hirundo, Caprimulgus, Trogon, Phasianus, Meleagris, Gallinago, Aramus, Strepsilas, Vanellus, Totanus, Tringa, Anthropoïdes, Sterna, Hydrochelidon, Larus, Anas,* etc.

From this list, we see that the species may be considered as univerally dispersed and really cosmopolite. If we compare the types of these various origins, we find no other difference than the size.

The form found by Mr. J. L. Hancock upon the flycatcher (*Phœnopepla nitens* Fer.), is absolutely the same that the typical *Syringophilus bipectinatus* from Europe. It cannot be placed in the genus *Picobia* (Haller) which possesses for differential characters :—*Pedes dissimiles; primi et secundi paris tarsus cirro longo, bifido, terminatus; tertii et quarti paris tarsus, unguibus binis recurvis et pectine duplici* (pulvillo) *instructus.*

On the contrary, the type figured by Mr. Hancock has the characters of the genus *Syringophilus:—Pedes omnes similes, unguibus binis recurvis et pectine duplici instructi.* This type is then connected with this last genus.

I must add that, from my observations, the form named "*Syringophilus*" is not adult and represents only the *syringobial and parthenogenetic* form of a species of *Cheyletus* described by Doctor S. A. Poppe (from Vegesack) under the name of *Cheyletus nörneri*[3], which is found also in the quills of the feathers of the birds enumerated previously, feeding on the Sarcoptids (*Analgesinæ*) which live there habitually.

I have lately[4] drawn the attention of naturalists to the habits of these various syringobial forms, and I have shown that the *Cheyletus nörneri* (Poppe), which devoured the *Pterolichi* and *Syringobiæ* which live in the quill, never touches the *Syringophili*, doubtless by virtue of the saying : "*les loups ne se mangent pas entre eux.*"

[3] S. A. Poppe, *Uber parasitische Milben* (Abhandl. Naturw. Ver. Bremen, [1887] X, p. 239, pl. II, fig. 4-5)

[4] E. Trouessart, *Sur le Mimétisme et l'instinct protecteur des Syringobies* (Bulletin de la Société Entomologique de France, 1894, p. CXXXVI).—*id., Sur la Parthénogenise des Sarcoptides plumicoles* (Comptes-Rendus de la Société de Biologie, 26 Mai, 1894 :—C.-R. Académie des Sciences, CXVIII, p. 1218).

It is not possible to find any differential sexual character between the two forms disinguished by Mr. Hancock as male and female. The form figured (plate XXII) is the syringobial nymph, and the other the parthenogenetic female.

In the interior of the quill, the *Syringophili* feed, according to the manner of the *Analgesinæ*, on the marrow (or pith) of the feathers. The transformation into adult *Cheyletus* takes place likely out of the quill, which explains why the syringobial form is found, but rarely, in the plumage, outwardly to the feathers, as in the case observed by Mr. Hancock.

As to the *Syringophilus uncinatus* Heller, it is a true *Cheyletus*.

In summary:

1. *Picobia villosa* (Hanock)=*Syringophilus bipectinatus* (Heller).

2. *Syringophilus bipectinatus* is a syringobial form of *Cheyletus nörneri* (Poppe).—Dr. E. L. Trouessart, Paris, France.

Preparing Orthoptera.—In Special Bulletin No. 2 from the Department of Entomology of the University of Nebraska Prof. Lawrence Bruner gives excellent directions for collecting and preserving Orthoptera. Regarding the process of "stuffing" he says:—"Within the past few years most of the objections that had so frequently been made to the gathering and preservation of orthopterous insects, have practically been removed by the adoption of different and better methods of preparing and preserving these creatures. A few of our specialists only seem to have profited from the discovery that these insects can be handled 'taxidermically,' *i. e.*, be stuffed in a similar manner as we would adopt for birds, reptiles and mammals, and thereby preserved in collections equally well with other forms. The following directions for collecting, cleaning and 'stuffing' orthopterous insects may, therefore, be of much value to those who contemplate making collections of and studing these insects. Instead of throwing the specimens in spirits (alcohol, brandy, whisky, etc.), when captured they should be killed in the 'cyanide' bottle from which they should be removed soon after death, and at once opened, cleaned and stuffed; or they can be transferred to a small tin or other box where they may be kept moist and flexible till arrived at home or in camp. Now take the specimens, one at a time, in the left hand, and with a fine, sharp-pointed scissors open the abdomen by cutting across the middle of the two basal segments on the lower side, then reverse and cut the opening a trifle larger by nearly severing the third segment. After this has been done extract all of the insides (intestines, crop, ovaries, etc.), along with the juices,

using a fine pointed forceps for the purpose, wipe out the inside of the insect with a small wad of cotton and it is ready to be 'stuffed' or filled up. When this latter is done the insect may be either pinned into a box prepared for the purpose at once, or it can be wrapped in paper and packed away for future use. To 'stuff' cut some cotton bat (raw cotton) in short pieces and fill up the insect through the opening previously made for cleaning it, using the same or a similar pair of forceps for the purpose, taking care not to fill too full nor to stretch the abdomen beyond its original dimensions. When the filling is completed carefully draw the edges of the several segments together and gently press the sides of abdomen into shape with the fingers. This can all be done, after a little practice, in about four or five minutes time. The advantage in favor of a specimen thus handled are several. It will not decay nor turn dark, the original colors will be retained more nearly perfect, and there is but little danger under ordinarily careful treatment of its being attacked in future by the museum pests mentioned. Specimens when thus prepared by an expert and properly labeled are easily worth three or four times as much for cabinet specimens as those not so cared for. Especially is this true with reference to specimens collected in warm, moist climates where decay is rapid, and where mould is sure to attack specimens that are long in drying."

Recent Literature.—Mr. H. G. Barber of the University of Nebraska publishes an interesting list[5] of Nebraska butterflies. One hundred and thirty-seven species are enumerated.

Mr. W. A. Snow contributes three dipterological papers to the Kansas University Quarterly for January, 1895. Professor S. W. Williston also contributes a paper on Exotic Tabanidæ to the same issue.

Mr. G. C. Davis publishes as Bulletin 116 of the Michigan Agricultural College Experiment Station a 24 page discussion of Insects of the Clover Field.

Prof. Lawrence Bruner discusses in 75 pages of the Nebraska Horticultural Report for 1894 the Insect Enemies of the Apple Trees and its Fruit.

In Bulletin 109 of the New Jersey Station Prof. J. B. Smith discusses cut worms, the sinuate pear-borer, the potato stalk borer and the insecticidal value of bisulphide of carbon. In Bulletin 106 the San José Scale is treated of.

[5] Proc. Nebr. Acad. Sci. IV, pp. 16–22, 1894.

Part IV of the valuable Bibliography of America Economic Entomology has been recently issued by the Department of Agriculture. It includes authors from A to K, and shows the same careful compilation by Dr. Samuel Henshaw as the previous issues of the series.

An important Report upon the Parasitic Hymentoptera of the Island of St. Vincent by Messrs. Riley, Ashmead and Howard has recently been issued by the Linnæan Society (Journal Zoology, XXV, pp. 55–254). The material was collected by Mr. H. H. Smith, and contained six new genera and 299 new species.

EMBRYOLOGY.

Origin of Twins.—Jacques Loeb of the University of Chicago contributes to the fourth part of Roux's new peroidical—Archiv. für Entwickelungsmechanik der Organismen—an illustrated article in which the results of his experiments upon echinoderm eggs are set forth along with a hypothesis of the mechanical origin of double embryos.

He found that when the eggs of the sea-urchin "Arbacia" were put into water less salt than normal the membrane might burst as if from osmotic pressure and part of the egg protoplasm ooze out from the rent. In case this extruded part remained in continuity with the rest of the egg farther development might result in the formation of a double larva.

Many most interesting double and triple larvæ so produced are figured with the abnormal skeletal structures seen in them.

The author then adopts the ideas of Quincke in an attempt to explain the production of double monster in general and in the higher animals in special.

Quincke regarded certain protoplasm movements as similar to those of oil and water when mixing in the presence of soda or of albumen. In such cases more or less violent "extension currents" are produced: currents which Bütschli would assume in the movements of the pseudopodia of an amœba on his hypothesis that protoplasm has a vescicular structure.

Professor Loeb assumes that mechanical currents are normally present in the process of cleavage and that in the abnormal process of double formation there is, for various unknown reasons, an exagger-

ated, violent stage of the same phenomena. When the vortex currents become violent, watery liquid accumulates between the cleavage cells so that they are separated and henceforth develop separately to form a twin.

It is to be regretted that the excellent observations recorded do not bear more forcibly upon the hypothesis advanced.

PSYCHOLOGY.[1]

Mental Development in the Child and the Race: Methods and Processes. By James Mark Baldwin, M.A., Ph.D., Stuart Professor of Psychology in Princeton University.[2]—Prof. Baldwin's latest book will prove of no less interest to the biologist than to the psychologist. There is a growing feeling that biology, the science of life at large, and psychology, the science of the inner life, since they deal with facts of the same order, must ultimately express those facts in essentially the same conceptions. To biology we must look for the most generalized expression of those conceptions; it will be the duty of the psychologist to apply them in his narrower field and to restate them with such additions and limitations as the facts demand. Yet, just because his field is the narrower, we may expect of him suggestions which will aid the biologist in his work. This is what Prof. Baldwin has undertaken to do. While studying imitation in the infant, he tells us, he was struck by the important part played by it in the development of the individual. This led him to read again "the literature of biological evolution with view to a possible synthesis of the current biological theory of organic adaptation with the doctrine of the infant's development," and this book is the outcome. It is full of original and suggestive material and I think I can do no better than give the readers of the Naturalist a fairly complete outline of its contents.

The arrangement of the book is open to criticism. The first six chapters deal with certain special problems and are intended to develop inductively the fundamental conceptions of dynamogenesis

[1] This department is edited by Dr. Wm. Romaine Newbold, University of Pennsylvania.

[2] Macmillan & Co., 1895. Price, 2.60.

and the circular reaction which underlie the entire book. These chapters, although of considerable intrinsic value, are superfluous so far as the main object of the book is concerned, in that their contributions to it might have been much more clearly put and in briefer compass. It is in the last chapter, on Suggestion, that the principal of dynamogenesis is most clearly stated: "The principle of contractility recognized in biology simply states that stimulations to living matter—the protoplasm of the higher vegetable and animal structures—if they take effect at all, tend to bring about movements or contractions in the mass of the organism. This is now also safely established as a phenomenon of consciousness—that every sensation or ingoing process tends to bring about action or outgoing process." (P. 166.) The movements thus produced may simply be repeated, thus forming a habit. But many of them "seem to beget new movements by a kind of adaptation of the organism—movements which are an evident improvement upon those which the organism has formerly accomplished." How is this done? This introduces us to the main problem of the book—that of Accommodation.

The answer is found in the Law of Excess. Of all the stimuli to which the organism is exposed some are advantageous. These heighten vitality and thereby increase the amount of motor reaction. In the case of advantageous stimuli the reaction is expansive, towards the source of stimulation, but the disadvantageous produce contractions, away from the source of stimulation. It is evident that the expansive movements are best fitted to secure the repetition of the stimulus, and the excessive discharge greatly increases this probability. If any one of these movements proves successful, there is a second excess discharge, but the second tends to pass out by the channels of the successful movement. This gives us the nucleus of a habit. The law that advantageous stimuli produce expansive movements and disadvantageous contraction is doubtless due to natural selection. (Pp. 199 et seqq.) The admission or denial of the inheritance of acquired traits would not affect this theory. And, since it represents selective reaction as part of the original endowment of life, and since this selective reaction is the organic analogue of pleasure and pain, we may say "that life began with consciousness, that is, with feelings of pleasure and pain. This position preserves the criterion of mind, making it also the criterion of life, and so assumes an absolute phylogenetic beginning of both life and mind in one." (P. 213.) From the preceding discussion the relation of Habit and Accomodation comes clearly to view. "Habit expresses the tendency

of the organism to secure and to retain its vital stimulus," (P. 216) while by Accommodation the organism "learns new adjustments simply by exercising the movements which it already has, its habits, in a heightened or excessive way."

Prof. Baldwin then undertakes to apply these principles to the explation of the phenomena of life, especially of human life. The first problem attacked is the origin of motor attitudes and expressions, which includes the theory of emotion. In the psychophysics of emotion in general the three factors, Dynamogenesis, Habit and Accommodation are clearly traceable. By the first every element of content must have its motor expression, but as no two contents are ever exactly the same, our reactions are constantly being modified by new motor elements. Habit, it is true, tends to diminish the amount of consciousness found in the reaction, but on the other hand, by increasing the total motor disturbance, it increases the consciousness of movement, which is a chief element in all emotion. It is, therefore, a factor in the genesis of emotion. By virtue of Accommodation such of the new elements contributed by Dynamogenesis as are useful to the organism get associated with and modify the old, thus increasing the total content of the emotional state. To this must be added the pleasures and pains of Attention, itself, as later to be shown, a form of motor accommodation. When we come to examine the special forms of emotion we find that the laws of expression formulated by other writers, such as the principles of antagonism, of direct motor discharge and of analogous feeling stimuli are readily explained as varying expressions of the laws above given. But we must note that in the individual the acquisition of emotional expression depends largely upon imitation.

Returning now to the fundamental type of reaction, we find that it involves: Stimulus—increased vitality—excess discharge ("random movements") towards source of stimulation—accidental securing of the beneficial stimulus by some one of these movements, thereby tending to make the same reaction easier—repetition of the process. This is best described as a circular reaction, since it tends to repeat itself, and as its nearest conscious analogue is found in imitation the whole class may be termed imitative. In the simplest form, as above described, it may be termed organic imitation. An examination of the responses to stimulations found in the lower forms of life, both animal and vegetable, shows that reactions of this type are coextensive with life itself. But in the higher forms, in which consciousness has been developed, the reaction assumes new forms. The stimulus produces

conscious experience, and its repetition repeats that experience. But the experience may also be repeated in the form of an *idea* without the occurence of the stimulus, and this idea may take the place of the stimulus and produce the reaction. This is termed conscious imitation, and is the germ of voluntary action. Furthermore these ideas, or copies, may be associated with one another, so that any one tends to awaken others and with them their appropriate reactions. Thus all the higher functions originate from and involve the lower. Sometimes, by the principle of lapsed links, the true stimulus may disappear and the movement be produced, to all appearance, by one of the associative antecedents of the stimulus.

Assimilation and Recognition.—The copy image may be so strong as to assimilate to itself the new experiences, their motor discharges uniting in one—this union in motor discharge is the basis of association by contiguity; association by similarity is found "when both of them, by association with a third have come to unite in a common discharge. The energy of the new presentation process finds itself drawn off in the channels of the old one which it resembles; the motor associations, therefore, and with them all the organic and mental elements stirred up by them, come to identify or unite the new content with the old." (309.) Assimilation then is due to the tendency of a new sensory process to be drawn off into preformed motor reactions. Some of these reactions are directly useful. Others constitute a more special kind of motor reaction upon the mental content. This latter is attention. It consists of three factors. First, the grosser muscular strains in brow, scalp, etc.; second, the more special strains of sense accommodation; third, the still more special strains peculiar to the content in question. When a new experience is repeated, not only is it assimilated to the memory of the original experience, but the third factor in attention is facilitated; these two constitute what we call recognition. (P. 314.) Upon the first factor of attention depends the peculiar sense of "warmth" or "ownership;" it is due to the fact that the attention strains constitute a large part of the sense of self. Recognition is an advanced form of adjustment to environment and has been of great phylogenetic significance.

Conception and Thought.—The principles already developed furnish a basis for the evolution of the higher mental processes. Judgment, or the demand for identity, is the conscious representative of the irresistible tendency to act in one way upon a variety of experiences. Belief is the conscious representative of the assimilation of new to old tendencies to action. Conception and per-

ception arise together when new experiences are brought face to face with old memories to whose motor tendencies their own can be but partially assimilated. In so far as assimilation takes place the concept arises; in so far as it does not the respective contents are discriminated as particulars, and this discrimination is the function of perception. By the omission of certain motor reactions peculiar to the several occurences of a common sensory content the latter is *abstracted*. Thus we see that the general or abstract "is not content at all. It is an attitude, an expectation, a motor tendency." (P. 330.) And when we recognize an object as belonging to a class, we mean that this object presents, in addition to the motor reactions peculiar to itself, motor reactions common to it and many other objects.

SYMPATHY is primarily due to imitation.—At times a new presentation is assimilated to memories of past experiences and thus awakens their emotional reactions—at others the sight of the emotional reaction in others provokes a similar reaction directly. To imitation the consciousness of self is also largely due. Its earliest form is found in a discrimination of persons as moving and especially interesting objects whose conduct at first admits of no exact calculation. This is the *projective* stage. The second stage is initiated by imitation of these projects; together with other bodily sensations the sense of effort then emerges and with it comes the vague consciousness of self as a *subject*. In the third stage the subjective elements thus gained are ascribed to the projects and they become *ejects* or persons like the subject. (Pp. 333 et seqq.)

THE ETHICAL FEELING originated in like manner—The child must accommodate himself to his environment, and especially to that part of his environment which we term the authority of others. But, as we have shown, one element of the self owes its origin to this very factor. Thus the intrinsic or habitual self tends to come in conflict with the self of accommodation and imitation. Later, from this external factor, is formed a "moral ideal of a possible, perfect, regular will taken over in me in which the personal and social self—my habits and my social calls—are brought completely into harmony; the sense of obligation in me in each case is a sense of lack of harmony—a sense of actual discrepencies in the various thoughts of self as my actions and tendencies give rise to others." (P. 345.)

The third form of imitation, which we may term plastic imitation, embraces those degenerated forms of reaction, which, having once been conscious, are now become secondarily automatic and subconscious. They fall under two classes; those that represent habitual

reactions and those that represent the imitative tendency itself become habitual. The first finds its expression in the community in conservatism; the second in liberalism.

VOLITION involves desire, deliberation and effort.—Desire consists of "(1) a pictured object suggesting associated experiences which it is not sufficient to realize, and (2) an incipent motor reaction which the pictured object stimulates but does not discharge." (P. 368.) Thus the germs of desire are present whenever a nascent movement is inhibited, but it is only when the representative element is added that it becomes typical desire. As desire arises from inhibited reactions, so does deliberation arise from the competition of reactions by the addition of analogous representative elements. Effort arises upon the resolution of a state of deliberation.

In persistent imitation we have the earliest form of volition. The "copy" is given and provokes a movement which only partially reproduces it. The apprehension of the movement as actually performed now constitutes a momentum prompting its repetition, but the original "copy" still persists, prompting a slightly different movement —out of the competition of these two reactions is formed a third, from these three a fourth, and so on until the movement as performed and the persistent "copy" prompt to the same movement—that is until the movement is successful. The sense of effort is due, as above shown, to the co-ordination or two or more such reactive tendencies. Thus we find in volition "the point of meeting of two principles, Habit and Accommodation, and their common function."

In the highest exhibition of reflective volition there is "no departure in type, however wide a departure it be in meaning and implications for philosophy—from the first organic reactions of organic life. Habit is formed in the face of suggestion through persistent imitation and volition, and Habit, made organic in character, is modified in turn by changed environment, which is reacted to by imitation and volition." (P. 388.) Prof. Baldwin then proceeds to present a mass of special evidence for the doctrines above outlined from the early life of infants, from some experiments made on students, from the intimate relation of attention to voluntary movement, from the phenomena of partial or total aboulia, especially as found in hysteria, idiocy and the various disturbances of speech. This last is of especial interest but is too technical in character to be given in abstract. Then follows a chapter on the Mechanism of Revival and Internal Speech and Song of which the same may be said. It is intended to illustrate the application of the theory to detailed instances.

"ATTENTION is the mental function corresponding to the habitual motor coordination of the processes of heightened or excess discharge." This theory finds a further confirmation in two facts. First, since the excess discharge is the sole means of accommodation in the lower organisms, and attention the only one in consciousness, we must connect in theory the function of excess with that of attention. Second, the excess discharge is also the organic analogue of pleasure and pain; attention, then should be the seat of pleasure and pain. This we find to be the case, especially in the pleasures of emotional and intellectual life. Since attention is a motor phenomenon, and since by the law of Dynamogenesis the more intense sensation has the greater effect, we readily see why an intense sensation tends to attract attention, and why attention tends to increase the intensity of the content attended to. It follows (P. 468) that attention is not a single function—there are as many attentions as there are contents. This fact has escaped notice because in all states of attention there is a certain relatively constant element, viz,: tensions in brow, jaws, skin of head, etc. "The office of attention is that of fixing the content steadily on the sensory side, and at the same time of releasing the associated discharge movements on the motor side. It is a go-between between the copy imitated and the imitation which copies it and is, therefore, *the central and essential fact in all voluntary muscular control.*"

I have gone somewhat at length into the analysis of this book because it seems to me a most important contribution both to biology and psychology. It may be described as an attempt to express all forms of conscious experience, from the lowest to the highest, in terms of their motor concomitants. In a sense the attempt is strictly legitimate. All mental states have motor concomitants, and since motion is the most essential fact in the life of the organism, and moreover, since movements are often more easily studied and measured than their accompanying mental states, it may well be that from a study of movement we may get those architectonic conceptions which all psychologists seek, but which have not as yet been got from introspection. But in the effort one is apt to exaggerate the genetic importance of the motor element, to ignore certain definite laws which introspection reveals, and to rest content with a careless and inadequate analysis of the psychoses which are to be explained. Against a large part of Prof. Baldwin's book these charges may be brought, and I think they rob many of his expositions of all practical value. Yet the book is full of acute observation and insight; one feels upon first reading it that he has here a mass of material of very unequal value, care-

lessly thrown together, whose exact value will come to view only after careful thought and study. Especially does it seem that the conception of the circular reaction and its genetic importance in the individual will remain a permanent acquisition of psychology.

ANTHROPOLOGY.[1]

Surprising Discovery of Ancient Rope and Netting in Southwestern Florida.—Lieutenant-Colonel C. D. Demford, late of the English army, has found in the recent months, a piece of well-preserved rope, a mass of string woven into the meshes of a net and several artificially shaped wooden billets, from two to three feet deep, in a deposit of soft, black mud, in one of the tide-water sea lagoons near Punta Rasso. These objects were associated with a necklace of shells and a well-preserved wooden dish, evidently of Indian make, and lay at a spot flooded daily by the salt tide, and encircled by one of the narrow ridges of oyster shells, now familiar to students, made by Indians, who feasted on molluscs at the spot. Here, as at other places on the west coast, the shells seemed to have been so arranged upon the low margins of the lagoons as to form small canals and water basins, where canoes could easily pass shoreward, and land on hard bottom when the tides were favorable. As far as I know, no such discovery as this of Lieutenant-Colonel Demford's has come to the notice of students in Florida before, but it remains to be proven, beyond reasonable doubt, that none of the objects, which rested on the shell bottom in the middle of the basin, and completely under the mud, worked their way down in recent times. Nevertheless, experience in digging out the bottom of drained lakes in Switzerland has shown us the effect of mud in preserving perishable objects of human make for long periods of time, and there is no reason why submarine deposits may not restore to us lost details of the past here as well as there. This brilliant and original work in Florida, directing investigation into a new channel, leaves us to wonder why no one thought of it before. The discoverer, while carrying many of the objects found to England, has kindly deposited a series of them at the Museum of Archæology of the University of Pennsylvania, to whose

[1] This department is edited by H. C. Mercer, University of Pennsylvania.

authorities he communicated the discovery more than a month ago, thus enabling Dr. William Pepper to send Mr. Frank Hamilton Cushing to the spot, and to take immediate measures to follow farther an entirely fresh line of research. H. C. MERCER.

SCIENTIFIC NEWS.

Indiana Academy of Science.—The Spring meeting of the Indiana Academy of Science was held at the Wyandotte Cave in Crawford County, May 15–17. The members and friends spent the greater part of two days exploring this great cave. The party made the three trips usually open to visitors. The total distance traveled in the cave was about twenty miles, and the greatest depth reached about 300 feet. This report must be too brief to enter into an elaborate description of the long and winding avenues, the grotesque shapes of the many beautiful stalactites, stalagmites and pillars, the grottoes, the pillared palaces, the large rooms and massive monuments and the numerous channels some of the diminutive kind that made it pretty difficult for some of the party to pass through. It is a fertile field for the geologist. The cave is made in the St. Louis limestone of the Carboniferous. Much gypsum was found as well as the various forms of the limestone; also magnesium sulphate and occasional layers of flint. In one part yellow ochre is found. The large white masses of Alabaster is especially noticeable in one part.

A few salamanders were found and several blind crayfish obtained from the guides. Many other animals have been found by previous investigators. It was a most enthusiastic meeting and also a very profitable one.—A. J. BIGNEY, *Ass't. Sec.*

The fourth session of the **Hopkins Seaside Laboratory** begins Monday, June 17, 1895. The regular course of instruction continues six weeks, closing July 27. Investigators and students working without instruction may continue their work through the summer. The Laboratory provides for three classes of students. 1. Investigators who are prepared to carry on researches in Morphology or Physiology. 2. Students in the departments of Zoology, Physiology, and Botany in the University, who wish to supplement their work under the favor-

able conditions of such an institution, and to gain a knowledge of the methods of research in Biology. 3. Students and teachers not members of the University, who desire te pursue biological studies and to become acquainted with the practical methods of laboratory work. For this group of workers regular courses are conducted in Zoology and Botany, accompanied by lectures and by individual instruction at the work table.

The corps of instructors embraces the followiug members of the faculty of Leland Stanford University. Dr. Oliver P. Jenkins, Dr. Charles S. Gilbert, George C. Price, Harold Heath, Charles W. Greene, Walter R. Shaw.

The following courses have been arranged: A course in Zoology, consisting of the structure, physiology, and life histories of typical marine forms. A course in Botany, consisting mainly of a comparative study of the principal groups of fresh water and marine algæ, with collateral work in other groups of plants. Both these courses will include instruction in laboratory methods and in microscopical technique.

More advanced courses in Morphology, Physiology, Embryology, Histology and Botany will be arranged for students who are prepared to enter such courses.

Those students who have had sufficient training to take up some original investigation will be given an opportunity to do so under the direction of an instructor.

The original building contains three general laboratories, a store-room, and seven private rooms for investigators. A new building contains a general lecture and library room, a general laboratory, ten private rooms for investigators, and a dark room for photographic work. The basement is designed for large aquaria. Both buildings are supplied with running water, both salt and fresh. The library and apparatus of the University are made use of in the Laboratory. Each student will be furnished with a good compound microscope. There is a good supply of reagents and supplies for microscopical work. Apparatus for work in experimental physiology is also provided. The Laboratory also possesses a fair supply of collecting apparatus, and two boats.

Location.—Pacific Grove is a seaside resort on the southern shore of Monterey Bay, two miles west of Monterey. It is reached by the Coast Division of the Southern Pacific Railway, and is about four hours distant from San Francisco. The coast line at this point offers every variety of rocky and sandy shores, and the variety and abund-

ance of marine life is exceptionally great. In the immediate vicinity of the Laboratory are exceptionally fine collecting grounds.

EXPENSES.—To investigators prepared to carry on original work the use of the Laboratory and its equipment is tendered free of charge.

Students in the Leland Stanford Junior University, will be charged a fee of fifteen dollars.

The fee for other students is fixed at twenty-five dollars for the term of six weeks.

Pacific Grove, is well supplied with boarding accommodations, with considerable range in price. Cottages and tents, furnished for light housekeeping, can be rented at reasonable rates. For further information address the Directors:

CHARLES H. GILBERT,
OLIVER P. JENKINS.

The Royal Academy of Science, Letters and Fine-Arts of Belgium offers prizes for Memoirs on researches concerning the following subjects: 1. Original investigations on the intervention of phagocytosis in the development of invertebrates. 2. Description of mineral phosphates, sulphates and carbonates found in Belgium, including the locality and formation in which the deposits occur. 3. Original investigations on the peripheral nervous system of Amphioxus, and, especially, the constitution and genesis of the sensory roots. 4. Original investigations on the mechanism of the cicatrization of plants.

The next meeting of the British Association for the Advancement of Science will commence on the 11th of September at Ipswich, under the Presidency of Sir Douglas Galton, F. R. S. The general secretaries are Sir Douglas Galton and A. G. Vernon Harcourt, F. R. S. The Presidents of the Sections are as follows:

Section A, Mathematical and Physical Science, Prof. W. M. Hicks, M. A., D. Sc., F. R. S.; Section B, Chemistry, Prof. R. Meldola, F. R. S., For. Sec. C. S.; Section C, Geology, W. Whitaker, B. A., F. R. S., F. G. S.; Section D, Zoology, Prof. W. A. Herdman, D. Sc., F. R. S.; Section E, Geography, H. J. Mackinder, M. A., F. R. G. S.; Section F, Economic Science and Statistics, L. L. Price, M. A., F. S. S.; Section G, Mechanical Science, Prof. L. F. Vernon Harcourt, M. A., M. Inst. C. E.; Section H, Anthropology, Prof. W. M. Flinders Petrie, D. C. L.; Section I, Physiology. This Section will not meet at Ipswich; papers on Animal Physiology will be read in Section D; Section K, Botany, W. T. Thiselton Dyer, C. M. G., C. I. E., F. R. S.

Ipswich possesses a fine Museum, founded by Professor Henslow, which contains a very complete collection of Crag Fossils. Geological excursions are being arranged to show the Crag Districts and the Cromer Cliffs. Marine dredging excursions will be made down the Orwell from Ipswich to Harwich. Excursions are also being organized to other places of special interest in the district around Ipswich, including Bury St. Edmund's, Colchester, the Norfolk Broads, Cambridge, Brandon, Wenham, Dunwich, etc. The seaside towns of Norfolk, Suffolk, and Essex are within easy reach.

The undersigned is engaged at present in a compilation of a complete directory of living botanists of all countries, inclusive of botanical gardens, institutes and societies, as also of their papers and the botanical publications issued by them. The undersigned, taking a lively interest in the accurracy of the directory, and in the exact insertion of your Christian and sur name, with full address, etc., etc., solicits, herewith, the favor of your kindly filling up the query sheet and returning it. The Boards of Botanical Gardens and Institutes are requested to send in a list of all the officials employed by them. Botanical Societies will kindly please to state their full name, year of establishment, and periodical publications (papers only partially treating on botanical matters included), and when published (yearly, monthly, etc.). Publishers of periodicals treating of matters relating to botany will greatly oblige the writer by their kindly stating the name, date and subscription price of their papers; at the same time the forwarding of proof-copies is requested.—J. DORFLER, I. and R. Technical Officier to the Botanical Section of I. R. Court Museum of Natural History, (Vienna) Austria, I. Burgring 7.

The collection of Fossil Mammalia made by Prof. E. D. Cope, was recently sold to the American Museum of Natural History of New York. It includes 470 species, of which 402 are types of species first described by Prof. Cope. The species were collected between 1872 and 1895, and were derived from eleven geological horizons.

Two of our paleontologists had the misfortune to break their arms during the winter that has just passed. We refer to Profs. Henry F. Osborn and Angelo Heilprin. Both have nearly recovered.